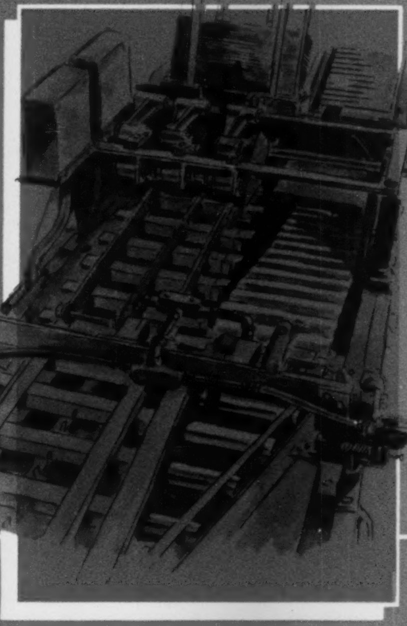
AUTOMATION

NOVEMBER 1959



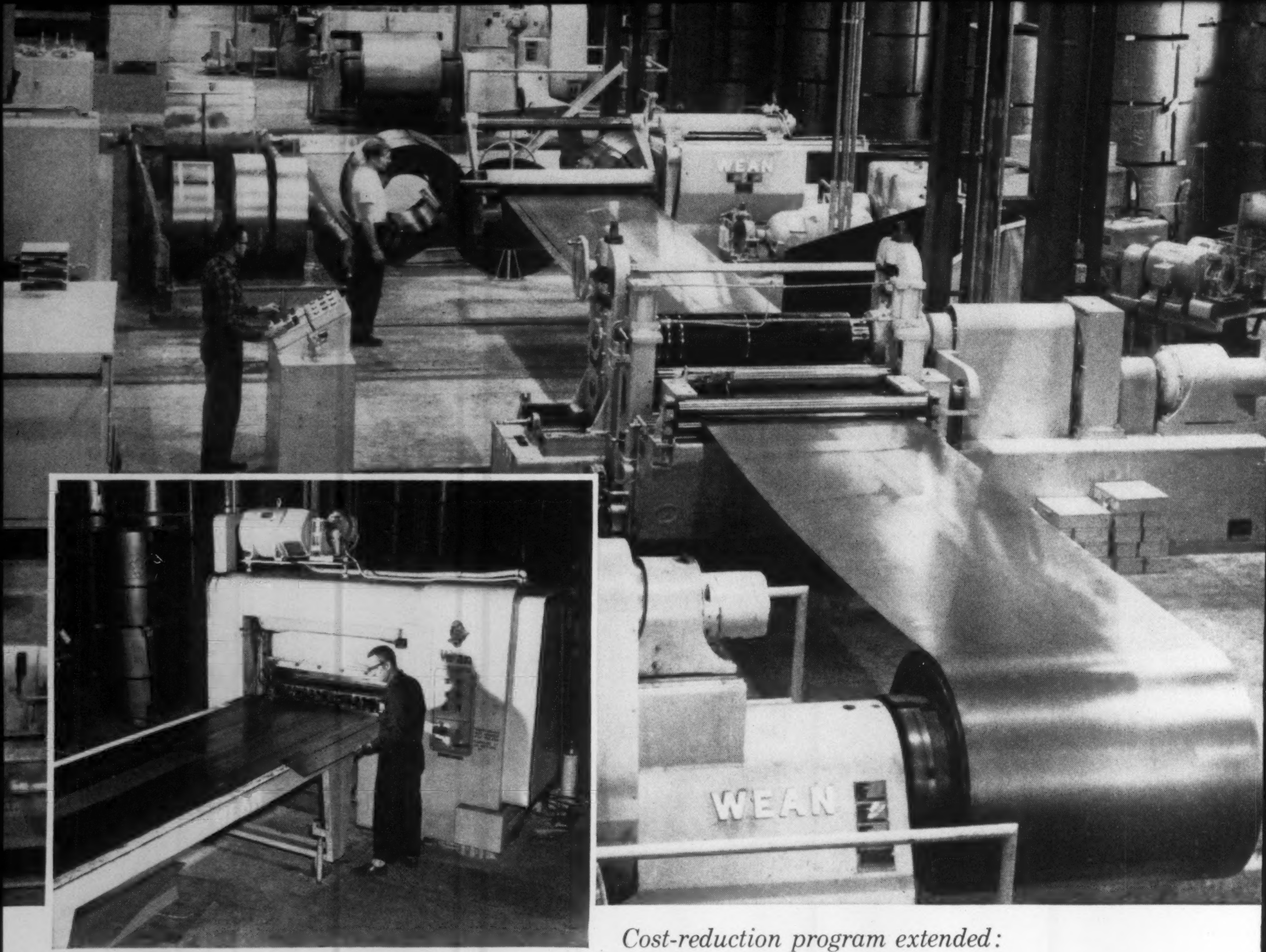
Integrating Packaging Processes

THE MAGAZINE OF AUTOMATIC MANUFACTURING OPERATIONS

- **Engineering Automated Equipment—Who Pays?**
- **Metering and Proportioning Flow**
- **Automatic Warehousing—The Concept**
- **Computer Controlled Power Generation**

CONTENTS — PAGE 3

A PENTON PUBLICATION



Cost-reduction program extended:

Lyon Metal Products, Inc., duplicates Wean coil processing lines at second plant

Lyon was one of the first metal fabricators to install its own coil processing equipment. At its Aurora, Ill. plant, Wean slitting and shearing lines were installed in 1953 to supply various sizes of resquared sheet directly from standard coil.

The 6 years' experience with this Wean coil processing equipment has thoroughly proved its economic value to Lyon. Inventory requirements have been reduced and major savings realized in purchased material and labor costs. Mr. J. B. O'Connor, an official of Lyon Metal Products says, "This Wean installation has performed so satisfactorily that we unhesitatingly duplicated it at our York, Pa., plant."

The new Wean equipment at York uses the versatile Wean "Flying Press" to cut lengths of 11″ to 96″ from slit coil varying in width from 3¼″ to 47½″. Strip is fed at up to 300 fpm with 1⁄64″ accuracy maintained on all cuts. Lengths are changed many times per shift, the simple adjustments being made by dial settings on the "Flying Press."

If your plant uses large quantities of sheet, you can cut costs by the use of Wean coil processing techniques. An experienced Wean sales representative will be glad to work with you on evaluating just how much you can save: most users have found the pay-off period to be less than two years. We'll be glad to send you more information.

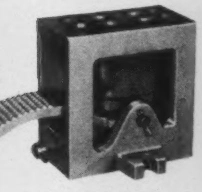
WEAN EQUIPMENT CORPORATION
CLEVELAND 17, OHIO
Detroit • Chicago • Newark

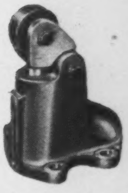
WEAN

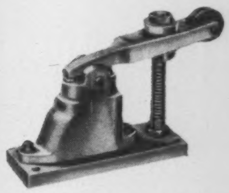
Circle 651 on Page 19

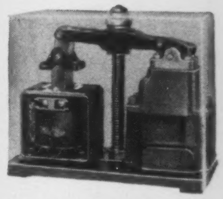
Give this valve your *ROUGHEST* jobs!

foot, cam,
solenoid versions
available, too


FOOT OPERATED


ROLLER CAM OPERATED


LONG-LEVER CAM OPERATED

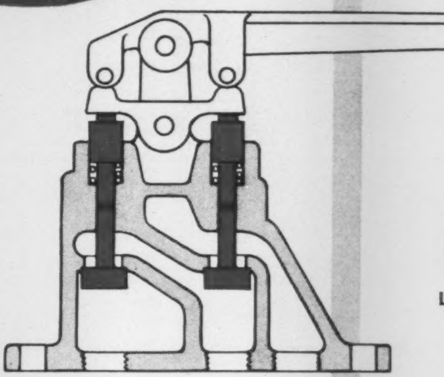

SOLENOID DIRECT OPERATED

ROSS

"100" Series

TOUGH-DUTY VALVE

ROSS
IN OUT EXH

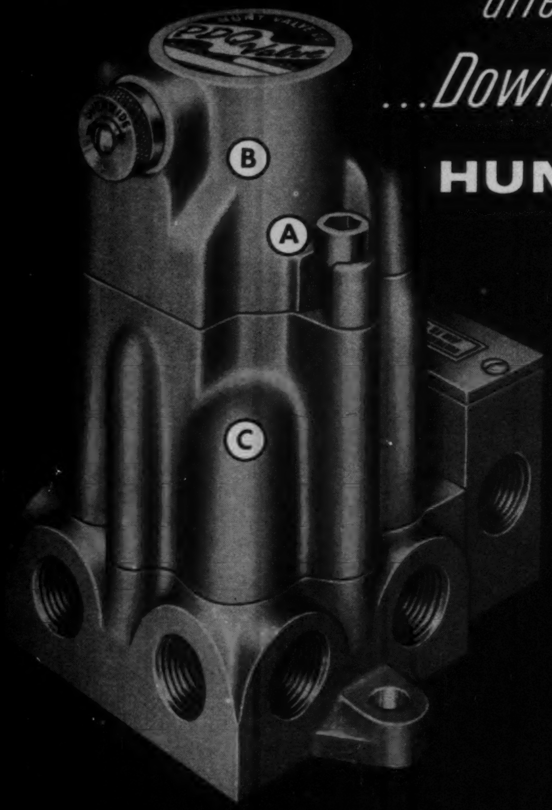


Steel mills, foundries, mines, offshore drilling, logging . . . these industries love the Ross "100" Series valve. Here's why: It performs well wherever you need a manually operated valve, but it is really the finest, most dependable valve available for use where the environment is rough and tough. The "100" Series valve will pass most dirt and foreign matter with no trouble and has only a few moving parts. Its poppets travel only a scant fraction of an inch, so it is especially wear resistant. It transmits a "feel" of control to the operator so he may "inch" a cylinder with fine control. Available in locking or non-locking, 3 way or 4 way, closed or cracked-to-exhaust-center models, with handle normally upright or horizontal. Write for further information.

STAY AHEAD
MODERNIZE

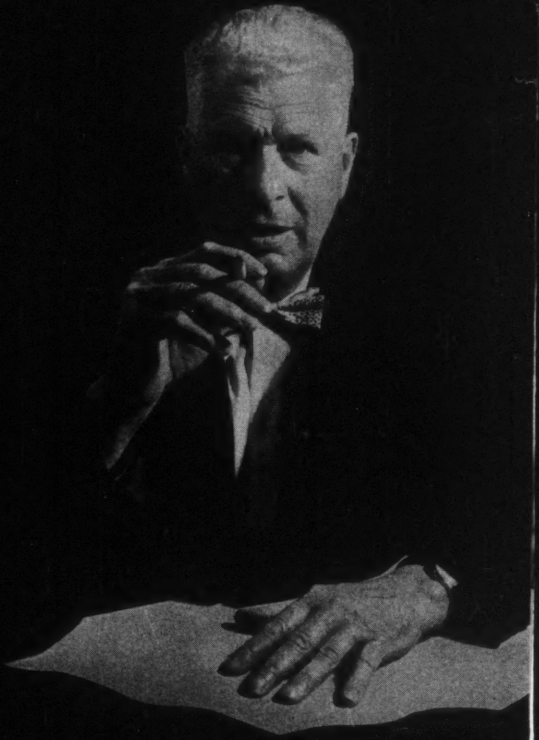
ROSS OPERATING VALVE COMPANY
131 EAST GOLDEN GATE AVE. • DETROIT 3, MICH.

Circle 654 on Page 19



after years of trouble free service
...Downtime—30 seconds with

HUNT'S *NEW* PDQ VALVE



You asked for a TOTALLY ACCESSIBLE air control valve

We built it. It took us three years . . . designing, field testing, redesigning. Here it is . . . the PDQ. The day (years in the future) when you have to change valves, if it's a Hunt PDQ, you do three things: (A) just loosen 2 cap screws; (B) twist pilot cap; (C) remove pilot cap and valve housing. No pipe to pull. No electrical splices to sever. No junction boxes to open. No electrical conduit to remove. It's plug-in.

Total downtime? I've replaced this valve myself in less than 30 seconds. You buy **trouble-free performance** and **minimum downtime.** I sell **trouble-free performance** . . . and **a new minimum downtime record.** Write today.

N C Hunt
N. C. HUNT, PRESIDENT

HUNT VALVE COMPANY · SALEM, OHIO, U. S. A.

- ☑ Accessibility
- ☐ Simplicity
- ☐ Speed and Capacity
- ☐ Price and Quality

The Hunt PDQ Valve tops them all in every class.

Next month . . .
the SIMPLICITY story.

HUNT HVC ***Quick-As-Wink*** AIR & HYDRAULIC CONTROL VALVES

NOVEMBER 1959
Vol. 6 — No. 11

AUTOMATION®

A PENTON PUBLICATION

The Magazine of
Automatic Manufacturing Operations

ROGER W. BOLZ, Editor

EDITORIAL STAFF
JAMES C. KEEBLER, Managing Editor
JOHN H. McRAINEY, Associate Editor
LEE D. MILLER, Associate Editor
WILLIAM E. STALHUTH, Associate Editor
JULIAN E. WILBURN, Associate Editor
JEANNE M. RIBINSKAS, Assistant Editor
HELEN M. VERESPY, Editorial Assistant

EDWARD D. KARL, Art Editor

EDITORIAL OFFICES
Penton Building, Cleveland 13, Ohio

A Matter of Class, 57
EDITORIAL—there is no alternative for detail planning in systems engineering if sound decisions are to be made in implementing programs.

Engineering Automated Equipment—Who Pays?, 58
ROGER W. BOLZ—comments by industrialists—both buyers and builders—highlight the search for an ethical answer to a vital problem.

Packing Peaches, 65
AUTOMATION TODAY—a perishable and easily bruised product is graded, packed, and prepared for shipment with aid of automatic equipment.

Integrating Packaging Processes, 68
J. E. WILBURN—packaging is but one step in a modern production system—the end product is an assembly of a package and its contents.

Yield Point Control, 77
METAL FORMING—exotic and conventional metals are handled on a production basis with automatically controlled stretch forming machine.

Sorting Glass Tubes by Weight, 79
PHARMACEUTICAL APPLICATION—machine classifies tubing prior to manufacturing operation in which small glass ampules are formed.

Continuous Casting Line, 80
INTEGRATED LINE—quantity users can produce own stock on equipment that takes molten metal and delivers strip in coils.

Metering and Proportioning Flow, 82
H. R. SMITH—variety of applications of controlled volume pumps in process systems attests to their usefulness as a final control element.

Automatic Warehousing—the Concept, 86
G. I. ROSS—increasing efficiency in manufacturing must be matched by efficiency in handling and storage if progress is to be maintained.

Computer Controlled Power Generation, 90
F. A. RITCHINGS and W. A. SUMMERS—power plant technology has reached the threshold of a major breakthrough in control techniques.

Automation in Action, 96
PICTORIAL PRESENTATION—improved machining, slitting to size, automatic storage, portable gage, and localized control.

Radio Controlled Phosphating Line, 98
S. A. CHOJNOWSKI and H. P. WHITTAKER JR.—parts weighing several tons each are handled efficiently by remotely controlled crane units.

REGULAR DEPARTMENTS

Automation Outlook, 4
Automation News, 9
Around the Triangle, 17
Equipment Index, 18
Readers' Reply Card, 19
Meetings and Events, 39
Detroit Dateline, 45
Western Trends, 51
New Equipment, 103
New Components, 123
New Literature, 155
Abstracts, 161
Confidential File, 170
Editorial Index, 172
Books, 174
Advertising Index, 175

←Circle 655 on Page 19

automation outlook

WHO PAYS FOR ENGINEERING?

". . . some equipment builders raise poignant questions concerning buyers of equipment who ask for free engineering or free servicing to an extent that is unreasonable. Others raise the point of demand for perfection or no pay even though their specifications may be vague or incomplete. Is there a really ethical and businesslike manner for handling new special equipment acquisitions that could be standardized as being fair to both parties involved in such a project? . . . Because 'who pays for the engineering' is an important question with automated equipment, an attempt at clarifying the problem is in order. Automation has ushered in an utterly different kind of situation with new equipment . . ."—*Roger W. Bolz, editor, see page* 58.

INTEGRAL FUNCTION

". . . industrial packaging can no longer be considered a separate operation which is performed in isolation from all other production operations. This turnabout in the traditional role of packaging products has been caused by the increasing application of automatic techniques to industrial processes. Automatic production systems are being designed to encompass all operations to be performed on the product from the receipt of the raw materials to the shipping of the completed product . . ."—*Julian E. Wilburn, associate editor, see page* 68.

PROGRESS THROUGH RESEARCH

". . . quite probably in any given industry there have been companies in the past that have not given sufficient consideration to research. These are the companies that no longer exist. They have been forced out of business by competitive concerns that were research-minded. As you know, our competitive enterprise system demands that industrial concerns must offer their customers products of constantly improved quality at prices they are both willing and able to pay. This is particularly true in the petroleum industry which is spending about $300 million per year in research. . . Much has been written about the improvements in techniques in refining processes that stem from research, and some about the effects of these changes on the people who are employed to operate and maintain the refineries. Several of the important maintenance crafts in a refinery where I was employed prior to World War I, such as teamsters (who drove horses), blacksmiths, brick masons, and lead burners, have all but disappeared. The scope of work of other crafts has changed to a considerable degree. The work of refinery operating people has changed to an even greater extent. As research and technological developments have advanced and expanded, jobs requiring increased talent and skills, at higher rates of pay, have been created. For example, during the period since 1914, the cost of living . . . has risen 188 per cent, but hourly wages of stillmen in petroleum refining have increased over 1000 per cent. Compare these figures with the fact that the retail price of oil products today is, exclusive of taxes, just about 50 per cent more than the price of the vastly inferior products in the year prior to World War I . . . these few facts demonstrate the degree of progress made over the last 45 years by the oil industry in serving the nation—progress made possible by huge investments in research. . ."—*Clarence H. Thayer, vice president, Manufacturing Dept., Sun Oil Co.*

AUTOMATION

Penton Building, Cleveland 13, Ohio
Main 1-8260

R. C. JAENKE
Business Manager

BUSINESS STAFF

LARRY D. BRENNAN, Advertising Sales Mgr.
ELIZABETH ROOT, Advertising Service Mgr.
J. M. CASTIGLIONE, Production Mgr.
S. F. MARINO, Promotion Dir.
J. C. GERNHARD, Circulation Dir.
R. J. SCHENK, Circulation Mgr.
JUNE SCHILENS, Reprints

Advertising Representatives

New York 17 ....60 East 42nd St.
EDWARD S. LAWSON, ROBERT S. MADDOX
Murray Hill 2-2581

Cleveland 13 ....Penton Building
JOHN D. SAUNDERS
Main 1-8260

Chicago 11 ....520 North Michigan Ave.
RICHARD W. JONES, RAYMUND A. GROSS
Whitehall 4-1234

Detroit 35 ....15800 West McNichols Rd.
BRADLEY MacKIMM
Broadway 3-8150

Los Angeles 5 ....730 South Western Ave.
The Robert W. Walker Co.
ROBERT W. WALKER, CHARLES F. MEISTER
Dunkirk 7-4388

San Francisco 4 ....57 Post St.
The Robert W. Walker Co.
ROGERS PARRATT, JOSEPH KELLER
Sutter 1-5568

Griffin, Ga. ....112½ East Solomon St.
FRED J. ALLEN
(Griffin) 8-8681

Dallas 35 ....818 Exchange Bank Bldg.
JAMES H. CASH
Fleetwood 1-4523

Clearwater, Fla. ....1954 Jeffords Dr.
H. G. ROWLAND
(Clearwater) 39-9493

London, S.W. 1 ....2 Caxton St., Westminster

Published by

THE PENTON PUBLISHING COMPANY

G. O. HAYS ....Chairman
R. C. JAENKE ....President
F. G. STEINEBACH ...Vice Pres. and Secretary
F. O. RICE ....Vice President
J. P. LIPKA ....Treasurer and Asst. Secy.

Also Publisher of

STEEL • FOUNDRY • MACHINE DESIGN
NEW EQUIPMENT DIGEST

AUTOMATION is selectively distributed without charge to plant and business management responsible for initiating use of automation; to production, plant and industrial systems engineers who plan and specify automated operations; and to engineers, designers and control specialists who design automatic machines, industrial systems and plants. Copies are distributed, to U. S. and Canadian companies only, on the basis of one for each group of four or five readers. Consulting and industrial engineering firms, research institutions and U. S. Government installations with similar responsibilities are also eligible.

Subscriptions in United States, possessions and Canada for home-addressed copies and those not qualified under above rules: One year $10. Single copies $1.00. Other countries: One year $20.

Published monthly and copyrighted 1959 by The Penton Publishing Co., Penton Bldg., Cleveland 13, Ohio. Accepted as Controlled Circulation Publication at Cleveland, Ohio.

When requesting changes of address, etc., please allow four to six weeks for processing.

BPA NBP

Circle 656 on Page 19→

. . . Fluid Power news

REPORT
No. 11,302
"ANY-SPEED"
DRIVE
UPS MILL
EFFICIENCY

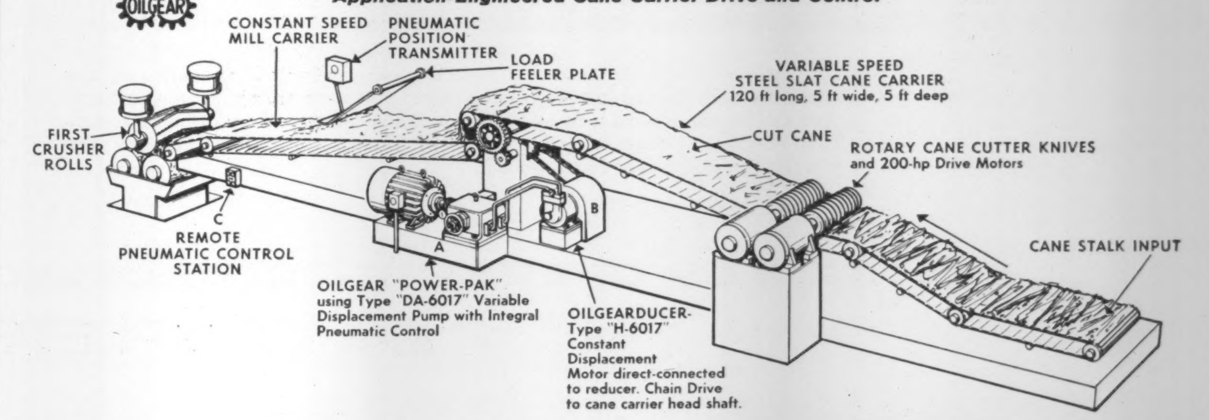
From Oilgear Application-Engineering Files

HOW OILGEAR "Any-Speed" DRIVE AND CONTROL SYSTEM AUTOMATED A SUGAR CANE CARRIER

CUSTOMER: A Large Sugar Cane Mill (Name on request).

DATA: To increase mill efficiency, and run at maximum capacity by maintaining an optimum flow of cut cane to the crushers, it was necessary to convert a conventional, manually controlled electric cane carrier drive to an automatic, load-sensitive, variable speed drive and control system with the following specific requirements: 1. An infinitely variable speed drive coupled with automatic "sensing" load-speed controls to exactly match cutter and crusher capacity . . . plus instant-stop overload protection as required by the following variables: 1a. Inconsistent carrier loading. 1b. Varying size and physical characteristics of the cane. 1c. Cut cane's tendency to "choke" or pile up at the crusher. 1d. Gradual efficiency loss as cutter knives become dull. 2. Automatic speed control, and stop, related to load. 3. Remote and manual control to start, stop, inch, and infinitely increase or decrease carrier speed. 4. Pneumatic controls, as mill personnel understand them. 5. Dependable, trouble-free for round-the-clock harvest operation, impervious to high humidity and daily washdowns.

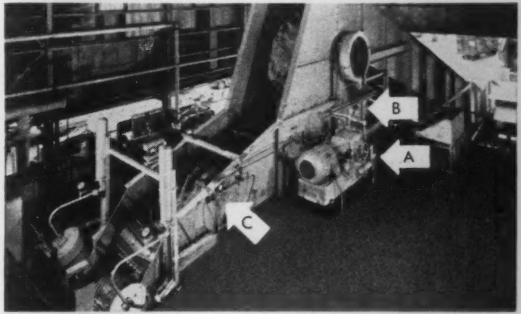
Application-Engineered Cane Carrier Drive and Control


CONSTANT SPEED MILL CARRIER
PNEUMATIC POSITION TRANSMITTER
LOAD FEELER PLATE
VARIABLE SPEED STEEL SLAT CANE CARRIER 120 ft long, 5 ft wide, 5 ft deep
FIRST CRUSHER ROLLS
CUT CANE
ROTARY CANE CUTTER KNIVES and 200-hp Drive Motors
B
C
A
REMOTE PNEUMATIC CONTROL STATION
CANE STALK INPUT
OILGEAR "POWER-PAK" using Type "DA-6017" Variable Displacement Pump with Integral Pneumatic Control
OILGEARDUCER-Type "H-6017" Constant Displacement Motor direct-connected to reducer. Chain Drive to cane carrier head shaft.

SOLUTION: An Oilgear "Any-Speed" Drive and Control System consisting of an Oilgear "Power-Pak," an Oilgearducer, and the pneumatic control system as shown above. This "Power-Pak" uses a Type "DA" Variable Displacement Pump with integral pneumatic control, a constant speed electric motor all mounted on a custom reservoir base. The Oilgearducer consists of an Oilgear Type "H" Constant Displacement Motor direct-connected to a reducer. Operating on a pressure differential of 3 to 15 psi, the integral, pneumatic, pump control system provides stepless, infinitely variable drive speeds from zero to maximum. A completely automatic control system increases or decreases carrier speed in response to preset percentage of knife motor load, and position of the feeler plate on the mill carrier section . . . carrier is instantly stopped by sudden peak overloads on the knife motors, or by raising of the feeler plate above a preset position. Carrier can also be started, stopped, inched, accelerated or decelerated from the remote stations, or with the manual handwheel on the Pump.

OWNER REPORT — after two seasons of operation — ". . . . *we began operations this season on January 9. We have been running under automatic operation since, and the results have been beyond expectations.*"

Right: A view of above installation. Oilgear "Power-Pak" (A), Oilgearducer (B), and one of the Remote Control Stations (C) are indicated.



Some of the "Plus Features" of this, and other Oilgear installations are: cushioned starts, stops, acceleration and deceleration . . . constant pressure and flood lubrication, and system fluid filtration . . . a "sealed" system, impervious to moisture-hazardous atmosphere . . . complete overload protection . . . long-life, trouble-free, efficient performance. Users say — *"for the lowest cost per year — it's Oilgear!"*

For practical solutions to YOUR linear or rotary Controlled-Motion problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to ....

THE OILGEAR COMPANY
Application-Engineered Controlled-Motion Systems
1598 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN

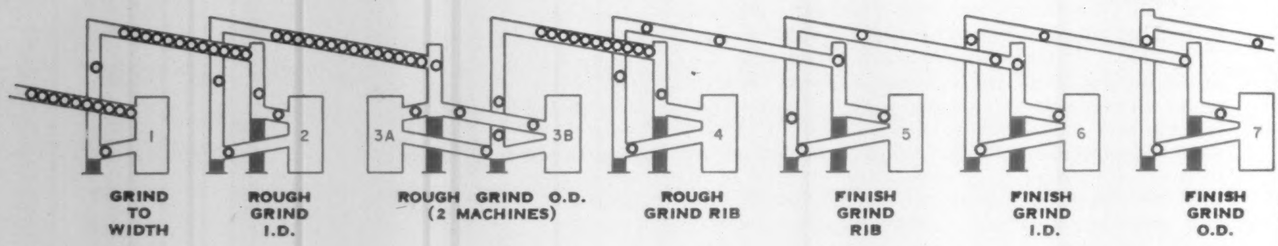
CINCINNATI
Grinding Machine Division

. . . AUTOMATES PISTON RELIEF GRINDING to with established production line

Modern automotive pistons are slightly elliptical on the skirt diameter, requiring special precision grinding equipment and a high degree of cost-reducing automation. Cincinnati's Grinding Machine Division solved these problems by designing and building compact, self-contained production machines completely equipped in every way including grinding wheels, and ready to install in an established production line.

Feature-advantages include: automatic loading and unloading equipment, synchronized with the automatic grinding cycle; automatic truing; automatic sizing. And the biggest advantage of all is Cincinnati's integration of performance factors, from the drawing board to application of the grinding wheel. Only Cincinnati gives you this completeness of responsibility.

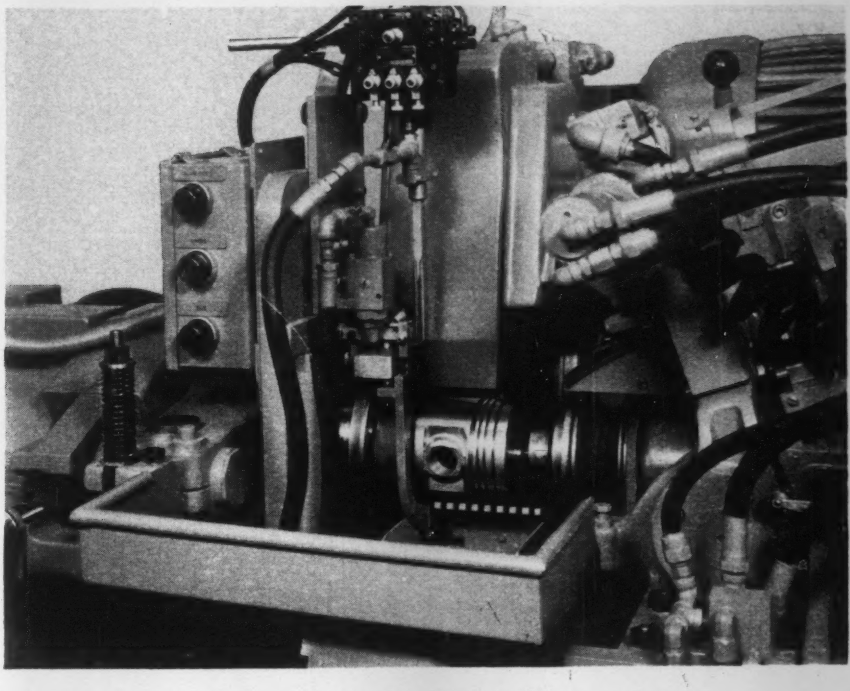
. . . BUILDS OPERATOR-CONTROLLED and COMPLETE


1
2
3A
3B
4
5
6
7
GRIND TO WIDTH
ROUGH GRIND I.D.
ROUGH GRIND O.D. (2 MACHINES)
ROUGH GRIND RIB
FINISH GRIND RIB
FINISH GRIND I.D.
FINISH GRIND O.D.

CINCINNATI

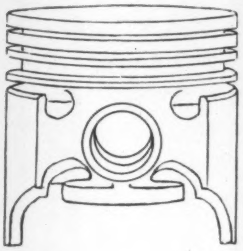
BUILDERS OF PRECISION GRINDING MACHINES: CENTERTYPE • CENTERLESS • MICRO-CENTRIC

THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO



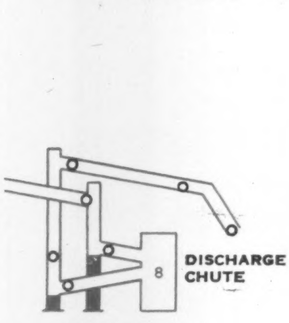
CINCINNATI FILMATIC Piston Relief Grinding Machine automatically grinds and sizes automotive piston. Production, 113 per hour.

keep pace



MACHINES

PRECISION GRINDING LINES



Operator-controlled CINCINNATI FILMATIC Grinding Machines are well known for their dependability and low-cost productivity. From the several types of these machines have evolved innumerable possibilities for precision grinding lines tailored to your requirements. The example diagramed here shows what can be done. It is an independent unit system, developed to grind five sizes of anti-friction bearing cones with a diameter range of 2 to 1. In all there are seven grinding and one polishing operation. Incorporated in the line are automatic sizing with feedback controls, automatic washing and demagnetizing, and a banking arrangement to take care of variations in production.

Cincinnati's outstanding degree of integration in supplying the complete equipment, including grinding wheels and electro-hydraulic and gaging equipment, is assurance of complete satisfaction with any machine or production line built by Cincinnati. May we give you more information?

• ROLL • CHUCKING • CENTERLESS LAPPING

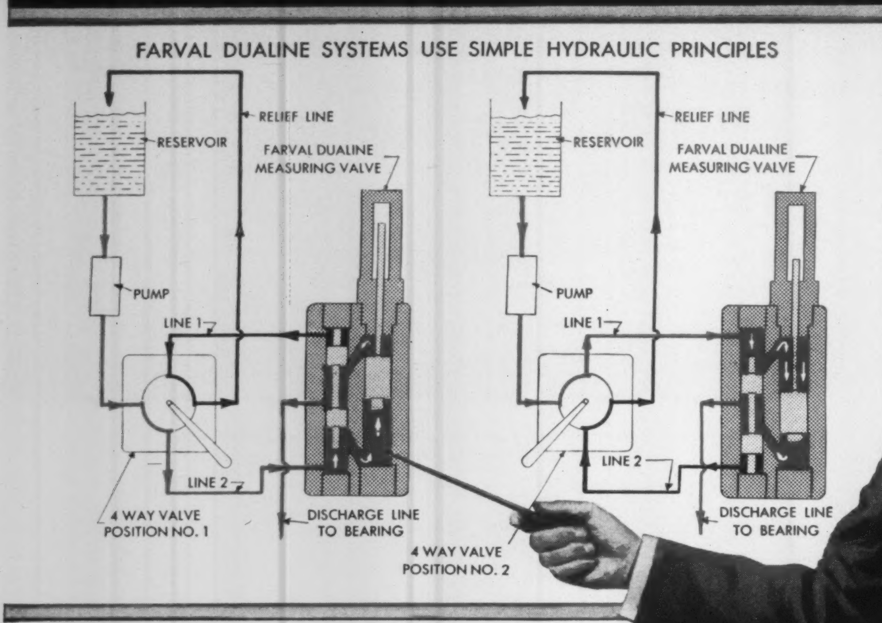
CINCINNATI

GRINDING MACHINE DIVISION

FARVAL
—Studies in Centralized Lubrication
No. 246

"For positive lubrication of large, medium and heavy-duty installations . . . it's a Farval Dualine System!"

FARVAL DUALINE SYSTEMS USE SIMPLE HYDRAULIC PRINCIPLES


RELIEF LINE
RESERVOIR
FARVAL DUALINE MEASURING VALVE
PUMP
LINE 1
LINE 2
4 WAY VALVE POSITION NO. 1
DISCHARGE LINE TO BEARING
RELIEF LINE
RESERVOIR
FARVAL DUALINE MEASURING VALVE
PUMP
LINE 1
LINE 2
DISCHARGE LINE TO BEARING
4 WAY VALVE POSITION NO. 2

With Farval Dualine centralized lubricating systems you get the following distinct advantages over other type systems . . .

(a) Much lower operating pressures with consequently less danger of soap separation on grease systems. Also, less danger of system damage due to high lubricant pressures.

(b) Large lubricant passages with no pinhole ports, ensures practically full pump pressure for every metering valve. This is one of the reasons why Farval Dualine systems operate on lower pressures — give less sieving and working of lubricants.

(c) Positive indication at each bearing — does not have to depend on the questionable action of a single indicator at the pump.

(d) Each metering valve individually adjustable for the requirements of the bearing it serves.

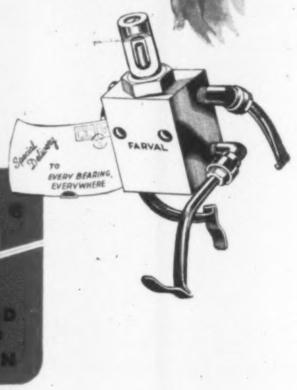
(e) Independent metering valve operation. Should trouble develop with one valve, the system will continue to operate. Only one bearing (not all the bearings) will require hand lubrication until trouble is corrected.

(f) True lubricant metering. Quantity of lubricant delivered to one bearing is not dependent on any other valve in the system.

(g) Much easier to spot and correct trouble.

Check with your Farval Representative and see how these versatile systems can improve production operations — reduce costs. Or write for free Bulletin 26-T containing complete engineering information on Farval Dualine systems. The Farval Corporation, 3265 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company
A subsidiary of Eaton Manufacturing Company

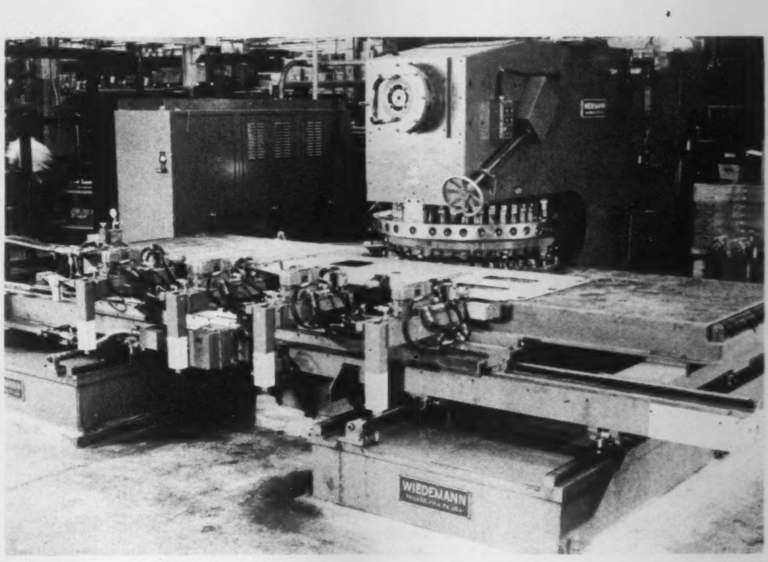

Special Delivery
TO EVERY BEARING, EVERYWHERE
FARVAL

FARVAL
CENTRALIZED SYSTEMS OF LUBRICATION

AUTOMATION news

Today's events and developments in the field of automation

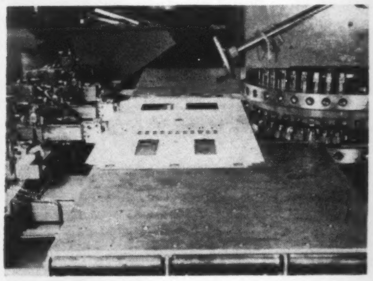
Punching Output Increased 400 Per Cent By Automatic Press



AUTOMATED turret punch press developed by Wiedemann Machine Co. uses a General Electric Co. Mark III positioning control system to position work table along two axes, to locate proper piercing tool and die from among 36 tool sets in turrets, and to operate punching cycle of press automatically. Press has a capacity of 100 tons and a 63-inch throat depth. Any punch and die combination can be replaced in 1½ to 3 minutes.

TAPE-CONTROLLED turret punch press which automatically locates and pierces holes in $^{3}/_{8}$-inch thick sheet metal or plate at a production rate of approximately 30 hits per minute has been put into operation at the Specialty Control Dept., General Electric Co. The automated punch press was developed by Wiedemann Machine Co. in cooperation with General Electric and is equipped with a modified G. E. Mark III numerical positioning control system which automatically directs all press operations.

The punch and die turrets of the 100-ton press are 55 inches in diameter and hold 36 tools. Tools used can be any shape and size up to 8 inches in diameter. The press was designed to produce at a rate of 20 to 40 hits per minute with an absolute hole accuracy of plus or minus 0.010 inch. For example, a press rate of approximately 30 hits per minute can be attained if the average table motion along both axes is 4 inches, average turret motion is 30 degrees, and turret changes are approximately 3 per minute. The turrets operate at a rotational speed of about 15 rpm.



METAL sheet is held by two automatic work holders while two other holders are in retracted position. Individual work holders automatically release sheet and withdraw to retracted position when clamp would interfere with piercing operation.

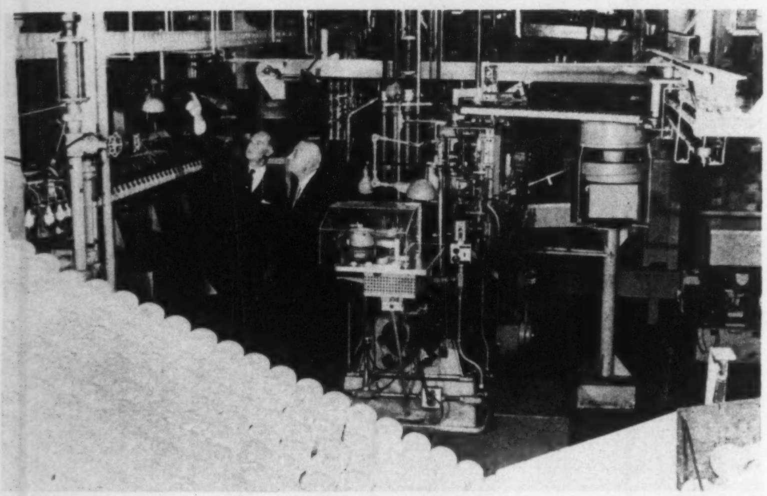
The press and positioning table are not connected, both being separately anchored to foundation. Table motions are powered by double rod end hydraulic cylinders which are controlled by high response, linear, proportionalizing servo valves. Maximum table speed is approximately 750 inches per minute.

Control information for the press is programmed on standard 8-channel, one-inch wide tape. Tape preparation is accomplished by using a standard tape punching machine and working to a simple work chart listing *X* and *Y* dimensions and turret station number for each opening. The punch press can be programmed to pierce holes at any point in a sheet up to 60 inches wide by 100-inches long.

After material has been loaded on the press table and tape has been inserted in the reader, the operator starts the press. In less than two seconds, the table moves the material to the first punching position and the turrets rotate the proper punch and die to the hole location. As soon as all three motions are completed, the press automatically trips. During the piercing operation, data for the next hole are read. As soon as the punch is retracted, the table and turrets immediately move to the next programmed position. Since all hole locations are measured from a zero reference, there is no accumulative error.

Automatic work holders, sensitive to signals generated by proximity pick-up, permit punching close to the edge of a sheet. When a pick-up head senses the nearness of the turret, the affected work holder jaws open, and the clamp is retracted. Conversely, when the head moves away from the turret, the work holder returns and reclamps the sheet. These units eliminate the necessity of interrupting the machine cycle for manual relocation of clamps to permit punching at the edge of sheets.

General Electric estimates that the automated punch press will produce a $48,000 cost reduction the first year of operation. In addition, they expect a $20,000 reduction in inventory as the press is 400 per cent faster and will eliminate the necessity of stocking large numbers of parts ahead of the next production operation. Over 2000 sq ft of floor space now required for sheet metal storage will be released for other manufacturing processes.



MANUFACTURE of incandescent bulbs is completely automatic on this 100-foot-long lamp-making machine developed by Westinghouse Electric Corp. Raw materials such as glass bulbs, filament mounts, bases, solder, lead wires, and silica coating material enter two parallel manufacturing lines of the machine on one end, and complete light bulbs emerge on the other. Product inspection is done electronically, and a memory circuit keeps track of individual bulbs that are improperly made. The machine then rejects the faulty bulbs at a rejection station. Finished bulbs are automatically packed into sleeves, inserted into cartons, placed on pallets, and conveyed to trucks or boxcars. Operators are needed only to monitor the electronic control system. The system is capable of producing 32 million light bulbs per year.

Foxboro Co. Forms Computer Control Group

FORMATION of a systems engineering group specializing in advanced application engineering phases of computer control in the process industries has been announced by Foxboro Co. The group, to be located at the firm's main plant in Foxboro, Mass., will be directed by **Robert Silva** of the Systems Engineering Div.

The new group will be mainly concerned with engineering complete control systems based on the use of either digital or analog computers along with Foxboro electronic and pneumatic instrumentation. Working closely with design engineering, sales engineering, and research teams, the systems engineering group will provide a comprehensive service for computer control users.

Later in the month the Radio Corp. of America and Foxboro Co. jointly announced that Foxboro will

Latest Developments In Packaging Machinery, Methods, and Materials

PACKAGING MACHINERY MANUFACTURERS INSTITUTE SHOW OF 1959

November 17-20, 1959 **New York Coliseum** **New York, N. Y.**

Sponsored By: Packaging Machinery Manufacturers Institute Inc.

What To See: A display of new and improved types of packaging machinery and packaging materials by 155 exhibiting companies. This will include labeling machines; wrapping machines; can, bag, bottle, envelope, and tube fillers; sealing machines; imprinting machines; carton formers; counting equipment; and bottle cleaners. Complementing the machinery displays will be exhibits showing electronic controls, scales, and mechanical components for integrating the packaging line. Other companies will be displaying packaging materials such as adhesives, plastics, foils, papers, cardboards, etc. Show management: Hanson & Shea Inc., One Gateway Center, Pittsburgh 22, Pa.

21st ANNUAL NATIONAL PACKAGING FORUM

November 16-18, 1959 **Statler-Hilton Hotel** **New York, N. Y.**

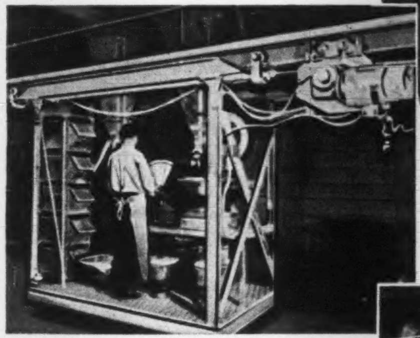
Sponsored By: Packaging Institute

What To Hear: A comprehensive program on packaging which will cover new materials, new methods, and new processes. The forum theme will be set on Monday in a keynote address, "Projecting Packaging Progress," by William C. Stolk, president of American Can Co. Monday afternoon, participants will have a choice of two seminars covering either packaging marketing or packaging research and development. All day Tuesday will be devoted to three concurrent seminars covering the developing of production lines and machinery, packaging drugs and pharmaceuticals, and printing in the packaging field. The conference will conclude on Wednesday with three concurrent seminars on industrial packaging, food packaging, and closures for high-speed aseptic packaging. Program information available from Charles A. Feld, Packaging Institute, 342 Madison Ave., New York 17, N. Y.

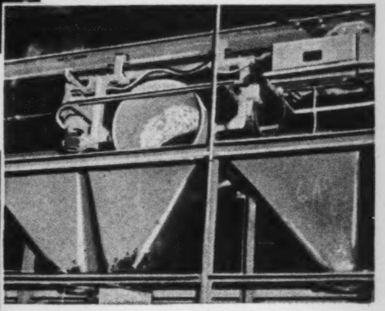
Automation in Action!

Louden Selectomatic Dispatch

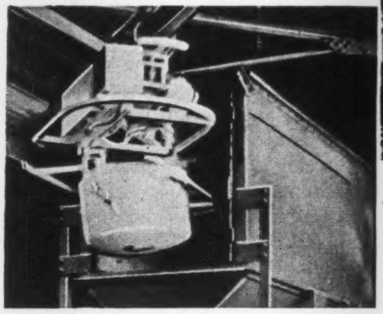
1 A Mixing Operator loads a carrier after electrically calling it on the control panel. After loading, he will select on the panel the carrier's destination and start its automatic journey.



2 A Mixing Operator rides a Louden Weighing Lorry selecting the grades of grits according to type of grinding wheel to be manufactured. Similarly, the various grades of bonding agents are selected.



3 Completely unattended, the Louden Selectomatic Carrier stops at a designated press hopper and dumps the mix.



4 After automatically dumping, the carrier proceeds to the cleaning station; opens and shuts doors, starts and stops an air cleaning jet which thoroughly cleans the bucket.

Get the latest information on the best in modern materials handling systems. Write today for your copy of "Economical Material Handling", a 52-page book full of how-to-do-it ideas. If you are interested in automation, ask for the new book on Louden Automatic Dispatch, "Automatic Materials Handling". With either you will receive the latest information on Louden Shok-Pruf Electrification, new safety in power for cranes and monorail systems.

Automation always brings its greatest gains by the waste it eliminates in *handling*. It saves time and it saves labor; uses men for their brains rather than their brawn, makes materials handling an aid to their skills rather than an unpleasant handicap. This is the way Louden automatic materials handling serves the world's most modern bonded abrasives plant of the Carborundum Company that was completed recently in Logan, Ohio.

This new Carborundum plant was *designed* to gain the benefits of automation with a Louden Selectomatic Dispatch System. Materials storage is on the third floor, materials mixing is on the second floor, molding of the mixed materials is on the first floor, with interfloor transfer of materials by gravity. The Louden equipment operates in the mixing and molding departments.

Mixing operators on Louden Weighing Lorries move from spout to spout drawing grits and bonding materials from the storage above and mix these according to formulae for the grinding wheels to be manufactured. Each mix is placed in a hopper at a loading station. Then, when a press on the floor below is ready for a mix, the touch of a Louden Selectomatic control button *automatically* brings an empty carrier into position under the proper loading station, directs the carrier to the hopper of the proper press, dumps the mix, sends the carrier to an automatic cleaning station, and then returns it to the "empty" line to await another call. Six such Louden Selectomatic Carriers operate over more than 1,700 feet of Louden Monorail to serve the many presses in this molding department.

When you are planning new production facilities or the extension on modernization of your present facilities, discuss your plans or problems with Louden engineers. No company in materials handling engineering has the years of experience, the array of equipment or the record of accomplishment Louden can demonstrate. Write or wire today.

Louden

MONORAIL & CRANES

THE LOUDEN MACHINERY COMPANY
9611 Broadway, Fairfield, Iowa
A Subsidiary of Mechanical Handling Systems Inc.

SINCE 1867 . . . THE FIRST NAME IN MATERIALS HANDLING

Circle 659 on Page 19

act as a manufacturer's representative for the sale of RCA's industrial computer products as well as providing specialized instrumentation and process information. According to **Theodore A. Smith,** executive vice president, RCA Industrial Electronic Products, "Foxboro and RCA are combining instrumentation, process control, and digital computer know-how to supply industry its first completely-integrated computing control system."

RCA has an industrial computer systems activity within its Electronic Data Processing Div. This group will supply the computer products, electronics engineering, and basic programming. RCA has recently announced a new all-transistor computer known as the RCA 110 which is suited for automatic control of many processes employed in petro-chemical, power, metal, and other major industries. Smith said, "This new equipment will be used for automation of materials handling in plants or warehouses, to solve complex engineering calculations, and in the control of industrial processes." The new computer employs advanced circuits and components from the RCA 501 which is a transistorized electronic data processing system for handling paper work.

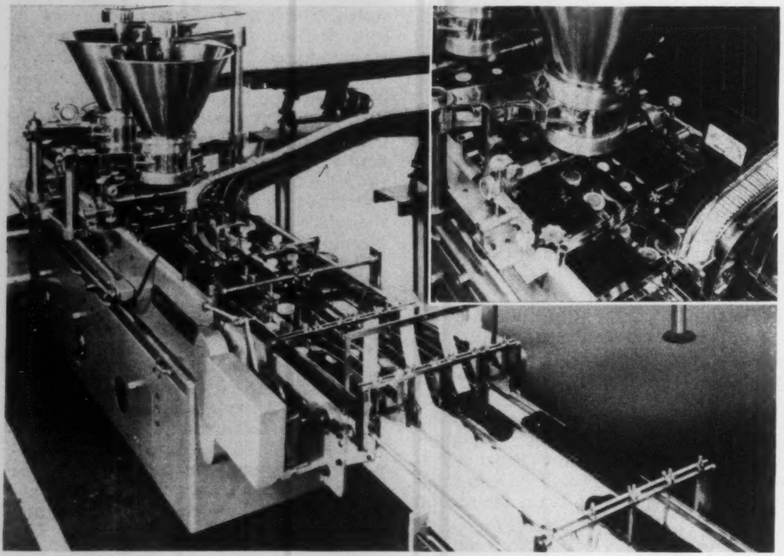
Plastic Coated Steel Strip Available In Continuous Coils

PROCESS for bonding a decorative, abrasion-resistant plastic coating to coils of strip steel has been developed by Enamelstrip Corp., subsidiary of National Steel Corp. The coated steel can be fed into manufacturing equipment and subjected to forming operations such as deep drawing, lock seaming, roll forming, shearing, crimping, bending, or piercing without damage to the decorated surface.

Depending upon the customer's requirement, the strip steel can be coated on both sides in the same color and thickness or in different colors and thicknesses. The material is presently being produced in widths up to 32 inches, and additional facilities are being installed for coating a 48-inch wide strip by the end of the year.

Coiled strip can be decorated in any color or pattern that can be photographed such as wood grains, leather, marble, and other special effects. The decorative suface is protected by a transparent, polyester plastic coating which is 10 times more abrasion resistant than materials presently in use for table and counter tops. The coating is also unaffected by most acids and chemicals, oxygen, and industrial fumes.

At the present time, joining of the coated metal is limited to mechanical means such as fasteners and crimping. However, new heat joining methods and the use of adhesives are being explored.



COOKIE sandwiching machine developed by Peters Machinery Co. processes two different flavors of cakes at the same time. Base cakes are conveyed from an oven and fed into two magazines at the rear of the machine. The cakes are then escaped onto two parallel conveyors which carry the units under separate filling hoppers. The rear hopper (inset) deposits vanilla filling on chocolate cakes on the right conveyor, and the front hopper places chocolate filling on vanilla cakes on the left conveyor. Magazine-fed top cakes are next automatically positioned on the filling covered base cakes and firmly pressed into place. The completed cookies are then delivered, stacked on edge, to packaging operations. Output of the machine is 1400 to 1600 cookies per minute.

Silk Screening Techniques Applied To Circuit Printing

USUAL method of producing printed circuit wiring is to first bond a sheet of copper foil to a ceramic or plastic base with adhesive and then remove unwanted material to obtain the desired pattern. Since the bond of the copper to the base is dependent on the strength of the adhesive, the circuit can fail during subsequent processing operations such as soldering or assembly.

Bell Telephone Laboratories has developed a new method for printing circuits directly onto a ceramic base that eliminates the use of adhesives. With the new process, a paste is prepared from a finely ground mixture of copper oxide and a special glass frit, both of which are blended with a silk screen printing vehicle. The circuit pattern is formed on the ceramic using standard silk screening techniques. After air drying to remove solvents, the printed card is fired in air for twenty minutes at 750C to burn off the printing vehicle. These operations leave a nonconducting copper oxide pattern, ready to be reduced to metallic copper.

A second firing operation in a controlled atmosphere is conducted for thirty minutes at 850C. The hydrogen in the atmosphere reduces the copper oxides to metallic copper, while the oxygen prevents reduction of other oxides in the system and promotes good wetting of the glass frit and the ceramic.

Printed wiring cards prepared by the new method can be soldered without bond failure and without the use of corrosive fluxes. The copper-to-ceramic bond is capable

Circle 660 on Page 19→

AUTOMATION
BEGINS
HERE

...with the most basic tools at an engineer's disposal: experience, a drawing board, and a complete catalog of instruments and controls designed for the automated process. That's why you'll find more and more design engineers coming to depend on the new General Controls *Automation Controls Catalog.* Here is a "working" catalog for the shirt-sleeves engineer, because it puts a complete diversified line of controls for automation in a single usable format. When you get yours, scan through it quickly. You'll find everything you need for that next job — program timers, actuators, automatic valves, sensing devices, potentiometers, and counters. There is also an experienced staff of field engineers ready to lend a hand when you need it. Send for your copy of this new catalog now.

GENERAL CONTROLS
Automatic Controls for Product or Process
Glendale, Calif. · Skokie, Ill. · Guelph, Ontario, Canada
Nine Plants — 44 factory branch offices
serving the United States, Canada and Western Europe

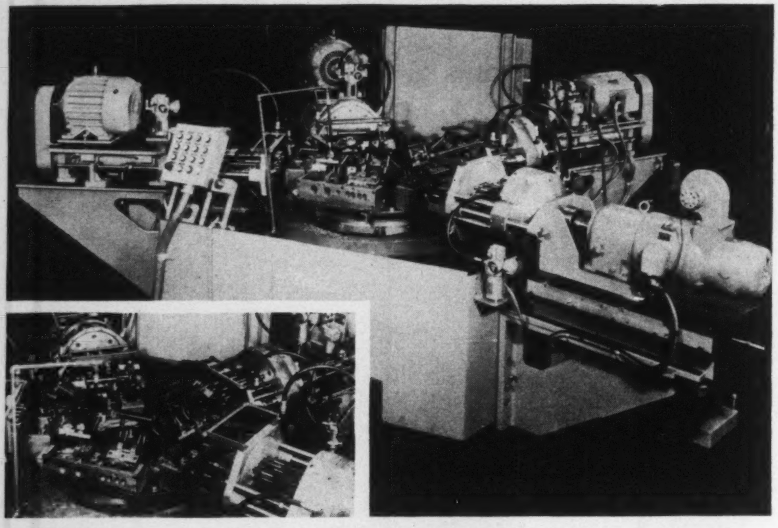
GENERAL CONTROLS CO. — Dept. 50C-L
8080 McCormick Blvd. • Skokie, Illinois, *or*
801 Allen Avenue • Glendale 1, California

Please send new AUTOMATION CATALOG.

Name____________________
Title____________________
Company____________________
Address____________________
City____________________State________

of withstanding a tensile test of about 2000 psi. Good bonds can also be developed when fired silver or fired molybdenum is used on ceramic bases.

The process was jointly developed by **Lucille Finneran** and **A. W. Treptow** of the laboratories staff and is suitable for automatic production techniques. In addition to printed circuits, the copper paste has other potential uses. With suitable modification of the vehicle, the copper can be applied with a brush or spray gun. When fired, these coatings form a good base for making metal to ceramic bonds, using lead-tin solders.



USING only four machining heads, 13 different parts having varying hole patterns can be drilled, countersunk, reamed, and tapped on this special machine built by Zagar Inc. This flexibility of operations is accomplished by using three different index tables which are sub-plate mounted and are removable as a unit, including all jigs and fixtures. Each table has 4 work stations and one load-unload station. Four brake wheel cylinder parts are processed at one time at each station. As the parts are indexed, they are drilled at the first station, drilled and countersunk at the second station, reamed and spot faced at the third station, and tapped at the last station. Output is approximately 700 parts per hour.

Magnetic Tape Readout Recorded on Microfilm

HIGH-SPEED recording system that "reads" magnetic computer tapes and records the contents on microfilm is being developed by the Apparatus & Optical Div., Eastman Kodak Co. The system is designed to cope with the high output of electronic computer data which are frequently stored on magnetic tape until they can be decoded.

As a magnetic tape is read, corresponding letters or numbers on the tape are displayed on the face of a cathode-ray tube. A special camera continuously photographs the tube face to record a full page of material on microfilm.

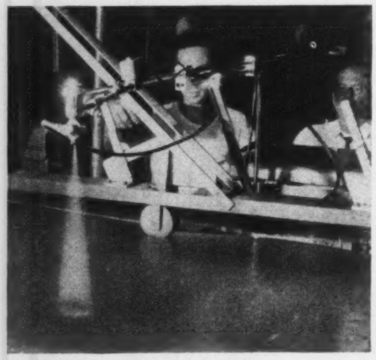
The system has a speed of 16,500 characters per second. As many as 66 lines of 130 characters can appear

Laminations In Steel Strip Spotted Ultrasonically

ULTRASONIC method of detecting imperfections in sheet steel that is being unwound at a speed of over 200 feet per minute has been developed jointly by Chrysler Corp. and Sperry Products Inc. The new technique resulted from an idea initiated by **E. A. Strohauer,** a staff methods researcher at Chrysler.

Strohauer became interested in the project after noticing the large numbers of auto body stampings that are scrapped because of laminations in the steel. This term is used to describe sheet steel having defects where there is a separation of the sheet into layers. By detecting the laminations before stamping, the company could save considerable time and money.

Since commercial equipment for high-speed detection of laminations was not available on the market, Strohauer initiated his own project for finding a fast method to inspect the steel. This project covered several years of effort and eventually led Strohauer to the idea of using ultrasonics. Sperry ultrasonic engineers were called in to collaborate on the development of an ultrasonic inspection system based on Strohauer's investigations.



The system ultimately worked out by the joint efforts of the two companies has been placed in operation ahead of a blanking press at Chrysler's Nine Mile Stamping Plant. As the steel strip is unwound from a coil stand, it moves under an ultrasonic detector at speeds up to 200 feet per minute. When a lamination is spotted by the detector, the change in sound signal actuates a nozzle which sprays the faulty metal with a colored dye. The marked sheet is then scrapped after it has been blanked out on the press.

A similar ultrasonic inspection system is also being tested to probe the interiors of spot welds. This system would examine 300 spot welds every 4½ seconds and reject faulty welds. Since there are approximately 3500 welds in a car body, a high-speed ultrasonic spot weld detector would provide the automotive industry with a much needed quality control technique.

announcing the

INDUSTRIAL DIVISION . . .

now supplying

electrohydraulic servo components

and systems

for industrial applications

from **MOOG:**

. . . the leading innovator and largest manufacturer of electrohydraulic servovalves

. . . pioneer in the application of electrohydraulic servos to critical control problems.

MOOG SERVOCONTROLS, INC. INDUSTRIAL DIVISION EAST AURORA, N. Y.

WRITE for bulletin PB–110 describing electrohydraulic servocontrol applications

JET ENGINE SUPPRESSOR

WITHSTANDS SUPERSONIC SHOCK

BUTTRESSED BY THE Saginaw b/b Screw

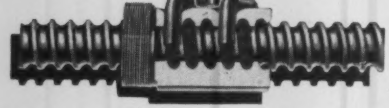
ANG
31294
MO ANG

Suppressor in use behind an Air Force F-86 H "Sabrejet"

Muting the ear-shattering roar of a jet engine on pre-flight "run-ups" is the job of Koppers Company, Inc.'s new Portable Run-Up Suppressor. And four Saginaw Ball Bearing Screws—flanking the body of the Suppressor—help hold it rock-steady against the full force of the jet engine's supersonic blast!

These Saginaw b/b Screws enable the Suppressor to be hand-raised or lowered into position faster and with far less effort than by any other manual means. The reason? The Saginaw b/b Screw converts *rotary* motion into *linear* motion with over 90% *efficiency!* And the dependable Saginaw Screw also played a significant part in keeping the Suppressor both light in weight and portable in design.

Whether you manufacture miniature electronic controls or giant production equipment, the Saginaw b/b Screw may be able to give *your* products that valuable **S**ales **A**ppeal you're looking for. To discover all the benefits it can bring you, write or telephone Saginaw Steering Gear Division, General Motors Corporation, Saginaw, Michigan—*world's largest producers of b/b screws and splines.*



Give your products NEW SALES APPEAL... switch to the Saginaw

ball/bearing Screw

WORLD'S MOST EFFICIENT ACTUATION DEVICE

around the triangle

NYLON TUBING CUTS INSTALLATION COSTS

Here's a unique way of cutting down installation costs on large-scale instrumentation systems. According to Allied Chemical Corp., a saving of $30,000 was made in installation and material costs by using Plaskon nylon tubing in place of copper tubing between central control panels and field instruments and valves at its National Aniline Div. plant in Hopewell, Va. Total footage used was 100,000 feet, and the maximum run for any one tubing was 325 feet. Ease of installation and elimination of all intermediate fittings between units accounted for most of the savings. A plus value gained was the opportunity to color code the system by using different colors of nylon tubing. Plaskon tubing is marketed by Allied Chemical's Plastics and Coal Chemicals Division.

AUTOMATIC GAGE CONTROL BY X-RAY SIGNAL

A large midwestern hot strip mill will soon use automatic gage control based upon an x-ray gage signal. Control equipment furnished by Allis-Chalmers Mfg. Co. includes two x-ray gages, magnetic amplifier regulators for adjusting stand speed, and digital positioning and proportional control for gage correction by screwdown adjustment. Designed to improve strip quality and gage, the system is being insalled on a 5-stand finishing train of the hot strip mill. Individual stand screwdown gage controllers include automatic reset of screwdowns at the end of each strip by using the digital position control. Also included is automatic tail-end gage correction by means of mill speed and selected screw recalibration. A production analyzer, employing digital positioning encoder devices, prints out gage deviation data, coil number, etc., for each coil.

MECHANICAL OPERATOR FOR STANDARD MACHINES

A machine which is designed to perform simple repetitive motions in a manufacturing line has been developed by the USI Robodyne Div., U. S. Industries Inc. Called a TransfeRobot, the machine is a mechanical version of an arm and a many-fingered hand. Operating from a programmed electronic control system, the TransfeRobot can seize, hold, pick-up, put down, turn, transport, and position parts and subassemblies. It can hold and operate various tools and can cause other machines such as presses, riveters, or welders to operate in conjunction with it at appropriate times. For example, in the assembly of fuse holders, the machine can obtain plastic bases from a magazine feeder and brass clips from a vibratory feeder, place the parts into a standard riveting machine, operate the machine, and remove the riveted parts. Production models of the TransfeRobot will be available by the middle of 1960.

A CHANGE AT THE HELM

Recently elected officers of the Packaging Machinery Manufacturers Institute Inc. begin 2-year terms of service on January 1, 1960. These include Kenneth B. Hollidge, executive vice president of Arthur Colton Co., as president of the PMMI; W. R. Huguenin, division manager of the Packaging Machinery Div., Food Machinery Mfg. Co., as first vice president; Harold Mosedale Jr., vice president of engineering at Package Machinery Co., as second vice president; and William W. Anthony Jr., vice president and executive general manager, Crompton and Knowles Packaging Corp., as third vice president. Elected to 3-year terms as directors of PMMI were Arthur E. Motch, vice president of R. A. Jones & Co. Inc.; J. H. Brezinski, president of Roto Bag Machinery Corp.; and Gene Lakso, vice president-sales of Lakso Co. Inc. Details of the 1959 PMMI Show can be found on page 10 of this issue.

INDEX OF EQUIPMENT BY ITEM NUMBERS

(New Equipment, New Components, and New Literature covered in this issue)

Adjustable speed drives, 486
Air
  cylinder, 456
  gages, 480
  line control, 459
Amplifiers, 509
  servo, 457, 467
Assembly
  machine, 423
  wire stitcher, 413

Bin level control, 461
Bread weigher, 401
Bridges, conductivity, 493
Buffing machine, 474

Chains, steel pintle, 447
Charting aids, 506
Clock, stop, 436
Compressor control, 492
Computers, 483, 498
Containers, wirebound, 484
Controlled volume pump, 432
Controllers, 493
  indicating, 430
  torque, 450
  weight, 401
Control centers, electrical, 508
Controls
  bin level, 461
  components, 477
  engine-compressors, 492
  tension, 431
  voltage, 468
  water, 488
  water level, 460
Converter, electromechanical, 438
Conveyors, 497
  checkweigher, 417
  dryer, 419
  gate lock, 414
  sanitary, 481
  vertical, 427
Counters
  binary decade, 449
  heavy-duty, 478
  switching, 469
Cylinder, air, 456

Data processing
  computer, 498
  digital computer systems, 483
  digital printers, 503
  magnetic tape converter, 425
  magnetic tape machine, 412
  magnetic tape tester, 420
  strain gage system, 403
  tape transport, 455
Decade counter, 449
Dehydration unit, 476
Detector, vibration, 453
Digital
  computer systems, 483
  data recording system, 403
  printers, 503
  voltmeters, 491
Drill head, 464
Drives
  adjustable speed, 486
  speed reducers, 479
  variable speed pulley, 433
Dryer, 476
Dryer, conveyor, 419

Electrical components, 429, 434, 437, 440, 443, 445, 452, 457, 462, 465, 467, 477, 494, 500, 502, 509
Electronic instrumentation, 495
Elevator, 407
Encoder, shaft position, 438

Fans, industrial, 499
Filter, 459
Forming machines
  can, 406
  tray, 408

Gages
  liquid level, 439
  tank, 451
Gaging, 480
  scanner, 471
Gas proportioning valve, 435
Gear shaper, 410
Generators, 494

Handling
  aerosol filling line, 402
  conveyor gate lock, 414
  conveyors, 427, 481, 497
  conveyor checkweigher, 417
  conveyor dryer, 419
  machine tool loader, 418
  parts, 407
  unloader, 422
  weighing machine, 409
Honing machine, 416
Hydraulic components, 444, 472, 487, 505
Hydraulic press brakes, 501

Indicator, electronic, 448
Instrument controls, 449, 454, 469, 478
Instrument indicators, 430, 448
Instrumentation
  electronic, 495
  photoelectric, 490
  systems, 473

Labeling machines, 424, 426
Level control, 460, 461
Limit switch, 437
Liquid level gage, 439
Loader, machine tool, 418
Lock, conveyor gate, 414
Lubricator, 459

Machine attachments
  web splicer, 411
Machine tool attachments
  drill head, 464
  loader, 418
Machine tools
  gear shaper, 410
  honing, 416
  milling, 405
Machines
  assembly, 423
  can former, 406
  labeling, 424, 426
  marking, 415
  packaging, 402
  polishing & buffing, 474
  presses, 482
  processing, 496
  taping, 428
  thread rolling, 504
  tray forming, 408
  welding, 485
  wrapping, 421
Magnetic tape
  converter, 425
  machine, 412
  tester, 420
Marking machine, 415
Measuring
  gaging, 451, 480
  level, 460, 461
  liquid level gage, 439
  meter, 442
  stop clock, 436
  torque controller, 450
  voltmeters, 491
Meter, liquid, 442
Meter-relay packages, 454
Milling machine, tape controlled, 405
Mixing head, 446
Molding, mixing head, 446
Motor control centers, 508
Motor starter, 429
Motors, 494
  synchronous, 445

Numerical control
  tape controlled milling machine, 405

Packaging
  aerosol filling line, 402
  can forming machine, 406
  case taper, 428
  containers, 484
  labeling machines, 424, 426
  tray forming machine, 408
  wire stitcher, 413
  wrapping machine, 421
Parts handlers, 407
Photoelectric instrumentation, 490
Planning, charting aids, 506
Pneumatic components, 444, 456, 463
Polishing machine, 474
Positioner, valve, 430
Power control unit, 470
Power supply, 509
Press brakes, hydraulic, 501
Presses, 482
  unloader, 422
Printers
  digital, 503
  miniature, 466
Processing equipment, 496
Pulley, variable speed, 433
Pump, controlled volume, 432

Rectifiers, selenium, 507
Reducers, speed, 479
Regulator, 459
Relays
  subminiature, 462
  time delay, 434, 465, 500

Scale, belt fed, 404
Scanner, 471
Selenium rectifiers, 507
Sensing
  vibration detector, 453
Servo amplifiers, 457, 467
Servo valve, hydraulic, 472
Shaft position encoder, 438
Solenoid air valve, 463
Speed drives, adjustable, 486
Speed reducers, 479
Splicer, web, 411
Starter, motor, 429
Stitcher, wire, 413
Strain gage system, 403
Strainer, porcelain, 441
Switches
  limit, 437
  pushbutton, 452
  silicon controlled, 502
Switching counter, 469

Tape
  converter, magnetic, 425
  machine, magnetic, 412
  tester, magnetic, 420
  transport, 455
Taping machine, 428
Tension control, 431
Terminal capper, 423
Testing, 475
  magnetic tape, 420
Thread rolling machine, 504
Thyratron tubes, 489
Time delay relays, 434, 465, 500
Timer, 436
Torque controller, 450
Transformer, regulating, 440
Tubes, thyratron, 489

Unloader, press, 422

Valves
  control, 444
  hydraulic, 487, 505
  hydraulic servo, 472
  positioner, 430
  proportioning, 435
  solenoid air, 463

Variable speed pulley, 433
Vibration detector, 453
Voltage
  control, 468
  divider, 443
  reference, 458
Voltmeters, digital, 491

Water
  control system, 488
  level control, 460
Web splicer, 411
Weighing
  controller, 401
  machines, 409, 417
  scale, 404
Welding, carbon dioxide, 485
Wire stitcher, 413
Wrapping machine, twist, 421

NEW EQUIPMENT . . . *page* **103** **NEW COMPONENTS . . .** *page* **123**
CATALOGS & LITERATURE . . . *page* **155**

AUTOMATION

Information Service

For your convenience, advertisements and items of information on new equipment, components and manufacturers' literature can be quickly identified by an *Item Number* accompanying each unit.

For additional free information circle item number on an inquiry card. Fill in your name, title, address, etc.—Drop it in the mail—Your request will receive prompt attention and will be filled directly by the manufacturer.

AUTOMATION **November, 1959**

SEND COPIES OF FOLLOWING ARTICLES IN THIS ISSUE

Page No. **Title of Article**

....

....

....

Circle item number for further information on anything described or advertised in this issue

Must Be Filled Out Completely—Type or Print

NAME ____________________

TITLE ____________________

COMPANY ____________________

PRODUCT MANUFACTURED ____________________

ADDRESS ____________________

CITY ____________________ ZONE ________

STATE ____________________

Do not use this card after January, 1960

401	441	481	521	561	601	641	681	721	761	801
402	442	482	522	562	602	642	682	722	762	802
403	443	483	523	563	603	643	683	723	763	803
404	444	484	524	564	604	644	684	724	764	804
405	445	485	525	565	605	645	685	725	765	805
406	446	486	526	566	606	646	686	726	766	806
407	447	487	527	567	607	647	687	727	767	807
408	448	488	528	568	608	648	688	728	768	808
409	449	489	529	569	609	649	689	729	769	809
410	450	490	530	570	610	650	690	730	770	810
411	451	491	531	571	611	651	691	731	771	811
412	452	492	532	572	612	652	692	732	772	812
413	453	493	533	573	613	653	693	733	773	813
414	454	494	534	574	614	654	694	734	774	814
415	455	495	535	575	615	655	695	735	775	815
416	456	496	536	576	616	656	696	736	776	816
417	457	497	537	577	617	657	697	737	777	817
418	458	498	538	578	618	658	698	738	778	818
419	459	499	539	579	619	659	699	739	779	819
420	460	500	540	580	620	660	700	740	780	820
421	461	501	541	581	621	661	701	741	781	821
422	462	502	542	582	622	662	702	742	782	822
423	463	503	543	583	623	663	703	743	783	823
424	464	504	544	584	624	664	704	744	784	824
425	465	505	545	585	625	665	705	745	785	825
426	466	506	546	586	626	666	706	746	786	826
427	467	507	547	587	627	667	707	747	787	827
428	468	508	548	588	628	668	708	748	788	828
429	469	509	549	589	629	669	709	749	789	829
430	470	510	550	590	630	670	710	750	790	830
431	471	511	551	591	631	671	711	751	791	831
432	472	512	552	592	632	672	712	752	792	832
433	473	513	553	593	633	673	713	753	793	833
434	474	514	554	594	634	674	714	754	794	834
435	475	515	555	595	635	675	715	755	795	835
436	476	516	556	596	636	676	716	756	796	836
437	477	517	557	597	637	677	717	757	797	837
438	478	518	558	598	638	678	718	758	798	838
439	479	519	559	599	639	679	719	769	799	839
440	480	520	560	600	640	680	720	760	800	840

AUTOMATION **November, 1959**

SEND COPIES OF FOLLOWING ARTICLES IN THIS ISSUE

Page No. **Title of Article**

....

....

....

Circle item number for further information on anything described or advertised in this issue

Must Be Filled Out Completely—Type or Print

NAME ____________________

TITLE ____________________

COMPANY ____________________

PRODUCT MANUFACTURED ____________________

ADDRESS ____________________

CITY ____________________ ZONE ________

STATE ____________________

Do not use this card after January, 1960

401	441	481	521	561	601	641	681	721	761	801
402	442	482	522	562	602	642	682	722	762	802
403	443	483	523	563	603	643	683	723	763	803
404	444	484	524	564	604	644	684	724	764	804
405	445	485	525	565	605	645	685	725	765	805
406	446	486	526	566	606	646	686	726	766	806
407	447	487	527	567	607	647	687	727	767	807
408	448	488	528	568	608	648	688	728	768	808
409	449	489	529	569	609	649	689	729	769	809
410	450	490	530	570	610	650	690	730	770	810
411	451	491	531	571	611	651	691	731	771	811
412	452	492	532	572	612	652	692	732	772	812
413	453	493	533	573	613	653	693	733	773	813
414	454	494	534	574	614	654	694	734	774	814
415	455	495	535	575	615	655	695	735	775	815
416	456	496	536	576	616	656	696	736	776	816
417	457	497	537	577	617	657	697	737	777	817
418	458	498	538	578	618	658	698	738	778	818
419	459	499	539	579	619	659	699	739	779	819
420	460	500	540	580	620	660	700	740	780	820
421	461	501	541	581	621	661	701	741	781	821
422	462	502	542	582	622	662	702	742	782	822
423	463	503	543	583	623	663	703	743	783	823
424	464	504	544	584	624	664	704	744	784	824
425	465	505	545	585	625	665	705	745	785	825
426	466	506	546	586	626	666	706	746	786	826
427	467	507	547	587	627	667	707	747	787	827
428	468	508	548	588	628	668	708	748	788	828
429	469	509	549	589	629	669	709	749	789	829
430	470	510	550	590	630	670	710	750	790	830
431	471	511	551	591	631	671	711	751	791	831
432	472	512	552	592	632	672	712	752	792	832
433	473	513	553	593	633	673	713	753	793	833
434	474	514	554	594	634	674	714	754	794	834
435	475	515	555	595	635	675	715	755	795	835
436	476	516	556	596	636	676	716	756	796	836
437	477	517	557	597	637	677	717	757	797	837
438	478	518	558	598	638	678	718	758	798	838
439	479	519	559	599	639	679	719	769	799	839
440	480	520	560	600	640	680	720	760	800	840

AUTOMATION
READER SERVICE

Use an Inquiry Card

. . . for further information on anything described or advertised in this issue. We will gladly send you a personal copy of any article so you won't have to clip this issue. Just fill in the page number and title of the article you desire.

FIRST CLASS
Permit No. 36
CLEVELAND, OHIO

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

—POSTAGE WILL BE PAID BY—

AUTOMATION
Penton Building
Cleveland 13, Ohio

Reader's Service Dept.

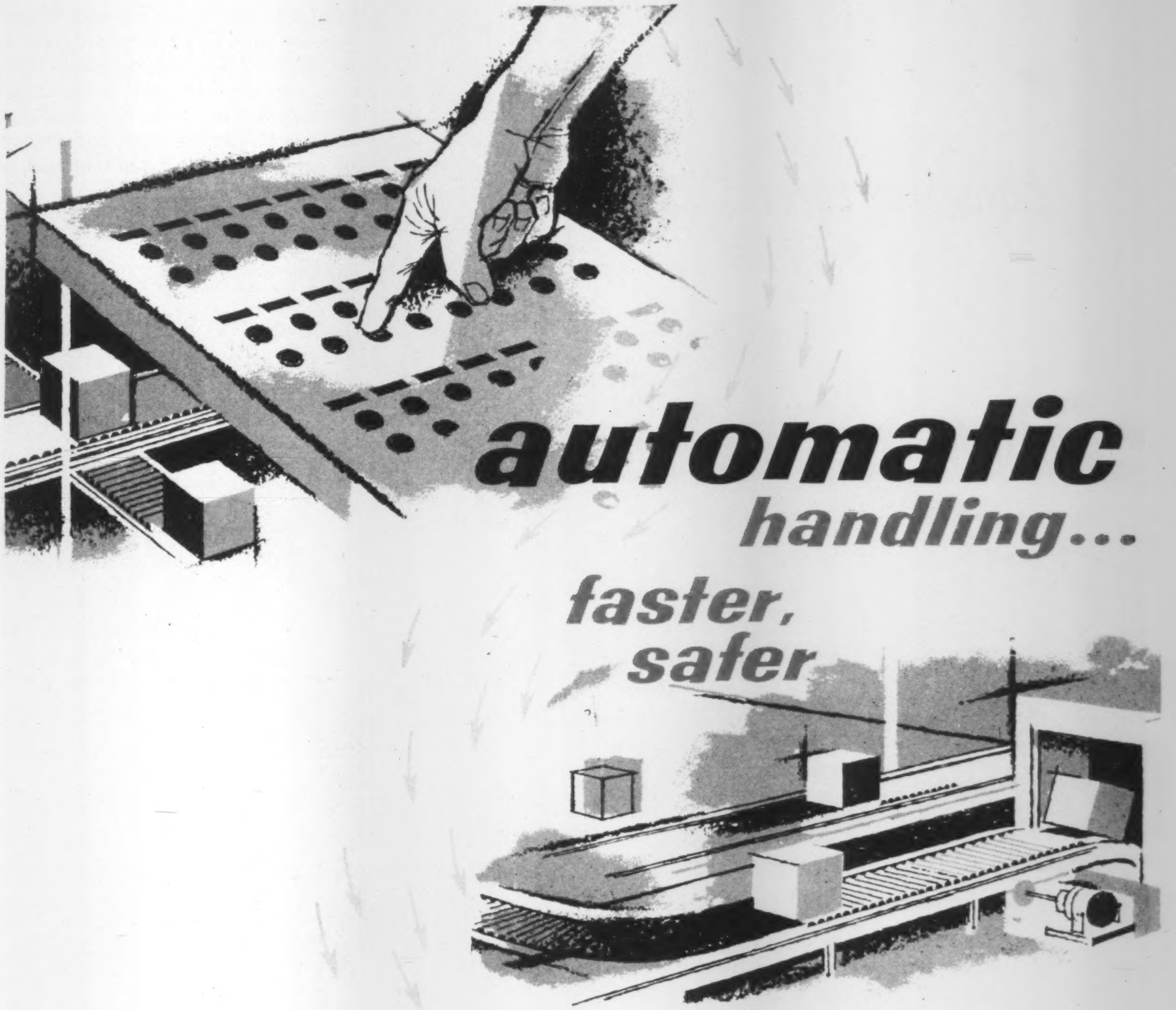
FIRST CLASS
Permit No. 36
CLEVELAND, OHIO

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

—POSTAGE WILL BE PAID BY—

AUTOMATION
Penton Building
Cleveland 13, Ohio

Reader's Service Dept.



ANOTHER REASON WHY INDUSTRY MOVES
BETTER ON ALVEY-ENGINEERED CONVEYOR SYSTEMS

Automation doesn't necessarily involve extensive plant-wide integration of materials movement. Alvey comes up with many ingenious ideas and methods that automate materials handling of segments . . . lines . . . and departments within plants.

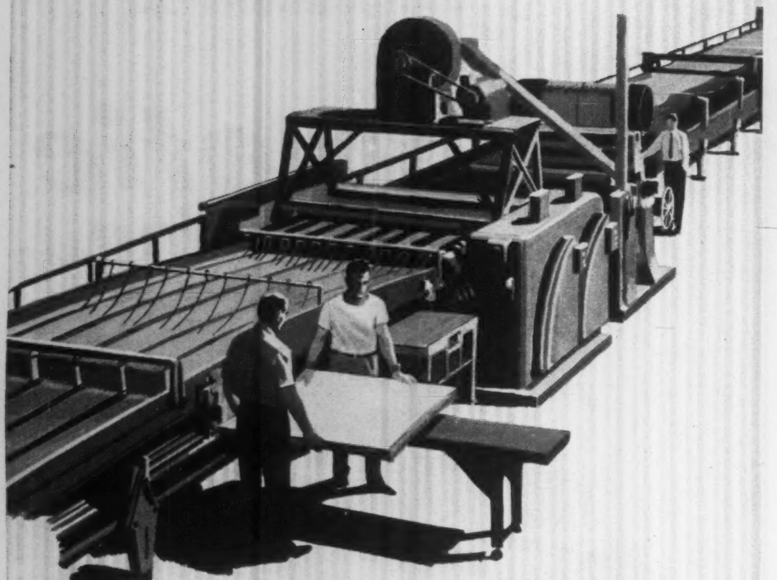
Alvey conveyor engineers keep their eyes on that **returnable** dollar. They create "pushbutton" movement of packaged goods and separate components—that not only saves time and manhours in the long run, but provides immediate returns on investment. Call us in to talk it over . . . no obligation!

ALVEY . . .
serving these famous names and many more

Philip Morris
Fairbanks Morse
Hiram Walker
Anheuser-Busch
Knox Glass
Pet Milk
ACF Wrigley
Pepsi-Cola
United States Steel

ALVEY
CONVEYOR MANUFACTURING COMPANY
9373 Olive Street Road • St. Louis 24, Mo.

ENGINEERED CONVEYOR SYSTEMS • PALLET LOADERS AND UNLOADERS • VERTICAL LIFT CONVEYORS
ROLLER, BELT, APRON, PUSHER BAR, SPIRAL, AND SLAT CONVEYORS • PACKAGE HANDLING SPECIALTIES



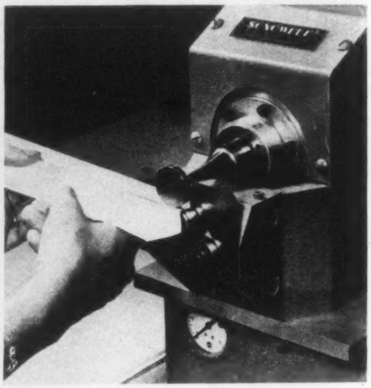
Corrugated boxes...
by the mile

Miles of corrugated board roll off giant H & D corrugators like this one every hour of the working day. This production assures you of prompt delivery of quality boxes in volume. Better see H & D.

Hinde & Dauch
Division, West Virginia Pulp and Paper

AUTHORITY ON CORRUGATED PACKAGING • SANDUSKY, OHIO
15 FACTORIES • 42 SALES OFFICES

as a page, and these are microfilmed at more than two frames per second. A roll of 1000 feet of 16mm film can contain decoded information from more than 35 reels of magnetic tape, and can be used for storage of data, viewing, or reproduction of results.



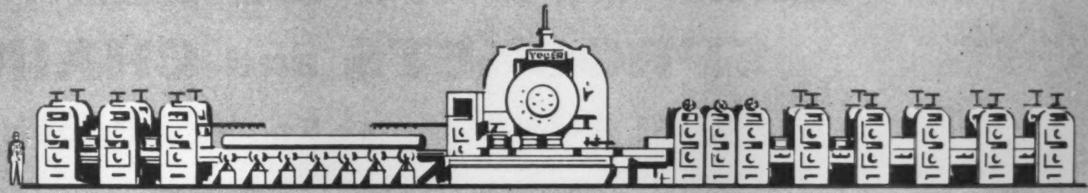
ULTRASONIC roller-welder developed by Aeroprojects Inc. in co-operation with Aluminum Co. of America seam welds 0.006 to 0.010 inch thick aluminum sheet and foil at speeds in excess of 30 feet per minute. Speeds above 100 feet per minute have been accomplished with thinner materials, and conservative estimates are that this rate will be doubled in the near future. The two companies are continuing development work on ultrasonic seam welding to increase welding speeds while using heavier aluminum sheet. Alcoa believes ultrasonic welding may result in more vigorous aluminum competition in the canning markets presently using the conventional soldered steel can.

Electronics Industry Grows Fastest In Western States

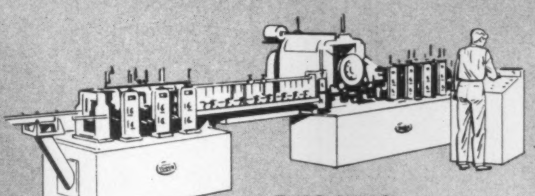
ELECTRONICS, the fastest growing industry in the nation, is growing fastest in the western states, according to **John A. Chartz**, president of the Western Electronics Manufacturers Association. Pointing out that growth is the cornerstone of any successful industry, Mr. Chartz said that electronics is approaching such industrial giants as steel, automotive, and petroleum in value of products.

In eleven western states, the electronics industry houses 18 per cent of the electronics firms in the nation, employs 19 per cent of the people in the entire industry, and does 23 per cent of the annual sales on a national basis. According to Mr. Chartz, since 1949 the number

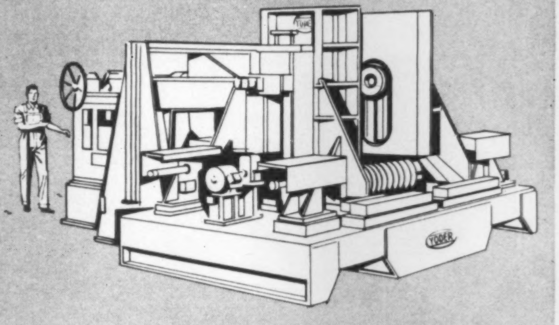
Circle 663 on Page 19



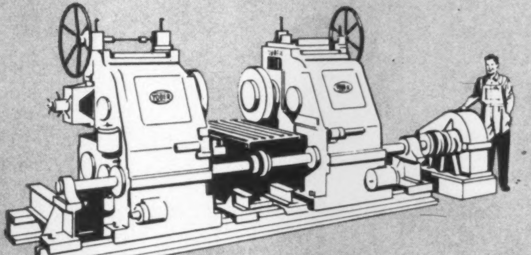
PIPE MILLS



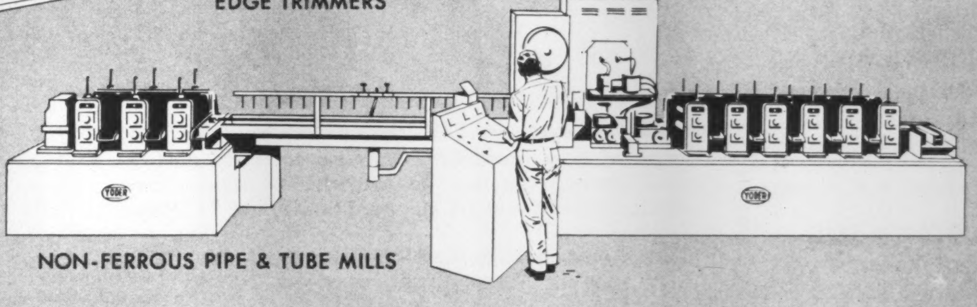
TUBE MILLS



HEAVY DUTY UNCOILERS



EDGE TRIMMERS



NON-FERROUS PIPE & TUBE MILLS

YODER
PIPE AND TUBE MILLS

Today's expanding markets and tightening economy demand closer production cost control. YODER'S complete line of ferrous or non-ferrous Pipe and Tube mills can help you meet production schedules economically . . . help you realize significant savings in the manufacture of tube and pipe.

YODER Pipe and Tube mills offer flexible production to meet fluctuating demand. They adapt easily to the most rigorous schedules. Everyday manufacture of constant high quality pipe and tube in diameter of 5/16″ to 24″. Speeds up to 350 fpm plus can be obtained with YODER mills.

YODER also makes a complete line of Slitting equipment and Cold Roll-Forming machinery. Send for your copy of the fully-descriptive book covering Tube Mill operation.

THE YODER COMPANY
5526 Walworth Ave. • Cleveland 2, Ohio

ENGINEERING
YODER
MANUFACTURING

PIPE AND TUBE MILLS (ferrous or non-ferrous)

COLD ROLL FORMING MACHINES

ROTARY SLITTING LINES

Circle 664 on Page 19

For complete chain drives ¼" to 2" pitch . . .

BOSTON Gear SPROCKETS and CHAIN

FROM STOCK . . . at Factory Prices

Catalog No. 57 lists

ANY TYPE OR SIZE YOU NEED

.81" to 50.94" P.D.
SPROCKETS, iron and steel,
for single ROLLER CHAIN

1.92" to 26.74" P.D.
SPROCKETS, iron and steel,
for double ROLLER CHAIN

¼" to 2½" P. ROLLER CHAIN
single, double, and triple strand

DOUBLE PITCH ROLLER CHAIN
1", 1¼", 1½" P. Drive Series
1", 1¼", 1½", 2" P. Conveyor Series
1", 1¼", 1½", P. Agricultural Series

1.94" to 12.74" P.D.
SPROCKETS, iron and steel,
for BLOCK CHAIN
⅛" to ½" w. BLOCK CHAIN

.37" to 6.07" P.D.
SPROCKETS, bronze and steel,
for LADDER CHAIN
.185" to .353" P. LADDER CHAIN
brass and steel

Save machining time

SHOLD-A-GRIP
interchangeable tapered
SPROCKETS and BUSHINGS
2.09" to 23.88" P.D. SPROCKETS
adaptable with tapered BUSHINGS
to shaft sizes ½" to 3" by 16ths

BORED-TO-SIZE
ready-to-install
SPROCKET PINIONS
Complete with keyway and setscrew.
⅜" through 1" P., in 86 pinion sizes,
with 360 stock bores

PLATE SPROCKETS
with or without hub
2.87" to 23.88" P.D.
BOSTON

Order from your local Distributor. You save time and expense — you get BOSTON Gear top-rated quality and lasting economy. Be cost-wise — standardize. Boston Gear Works, 95 Hayward St., Quincy 71, Mass.

CALL YOUR NEARBY
BOSTON Gear®
DISTRIBUTOR
— STANDARDIZATION PAYS —®

For nearest Distributor LOOK UNDER "GEARS" in the 'Yellow Pages'

9496 "OFF-THE-SHELF" TRANSMISSION PRODUCTS **FROM STOCK** — AT FACTORY PRICES — ASK FOR CATALOG
Stock Gears • Sprockets and Chain • Speed Reducers • Bearings • Pillow Blocks • Couplings

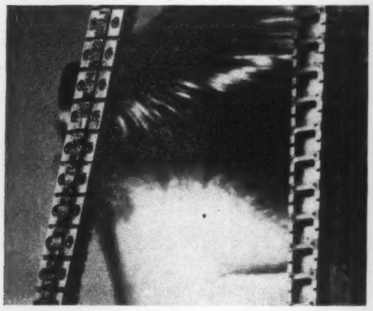
Circle 665 on Page 19

of firms engaged in electronics in eleven western states has jumped from 85 to 770, employment has risen from 11,000 to over 146,000, and annual sales have increased from $158 million to nearly $2 billion. None of these figures include aircraft or broadcast service revenues.

The largest single area, Los Angeles-Orange County, has 461 electronics firms employing 84,000 persons. Annual sales volume in this area alone is over $1.1 billion. The next largest area is the San Francisco-Peninsula territory with 144 firms, 40,000 people, and an estimated sales volume of $439 million. The remaining areas in the eleven western states have less than 36 firms each.

System Transmits Shop Data To Plant Office

DATA handling system for the transmission of up-to-the-minute reports from a production line to a plant office has been developed by International Business Machines Corp. Line operators send their reports by inserting punched cards into input stations serving their job locations. Data are automatically transmitted and reproduced on other



ALPHABET printing chain is the heart of a new printer developed by the Data Processing Div., International Business Machines Corp., for use in a transistorized data processing system. In operation, the chain travels horizontally across the face of paper forms at a speed of 90 inches per second. In alignment with the high-speed chain is a fixed row of 132 electronically-timed hammers. As the chain moves, a scanning operation compares the characters on the chain with characters in storage awaiting printing. When a character on the chain matches the one in storage, the hammer for the printing position is fired. This presses the paper and ink ribbon against the type character, causing it to print. Output of the printer is 600 lines per minute.

To Put New Life in Your Plant With A-F *Engineered* Plant-Wide Movement of Parts, Assemblies, Products, Cartons.

JUST 1 MAN—sitting at a control panel can automatically, start, route, switch or stop the movement of component parts, assemblies, products, cartons and cases in all parts of your plant.

Cases may be automatically counted as they are being moved. Visible and audible signals prevent traffic jams.

While A-F also produces many types of "do-it-yourself" conveyor components, we firmly believe that only an A-F *Engineered* Conveying System will give you real operational savings, lower maintenance costs, free money tied up in in-process inventories, reduce paperwork and recover floor space you need for more productive uses.

Why not write us—without obligation—today?

YOU CAN SEE
THE SUPERIORITY
OF A-F CONVEYOR ENGINEERING

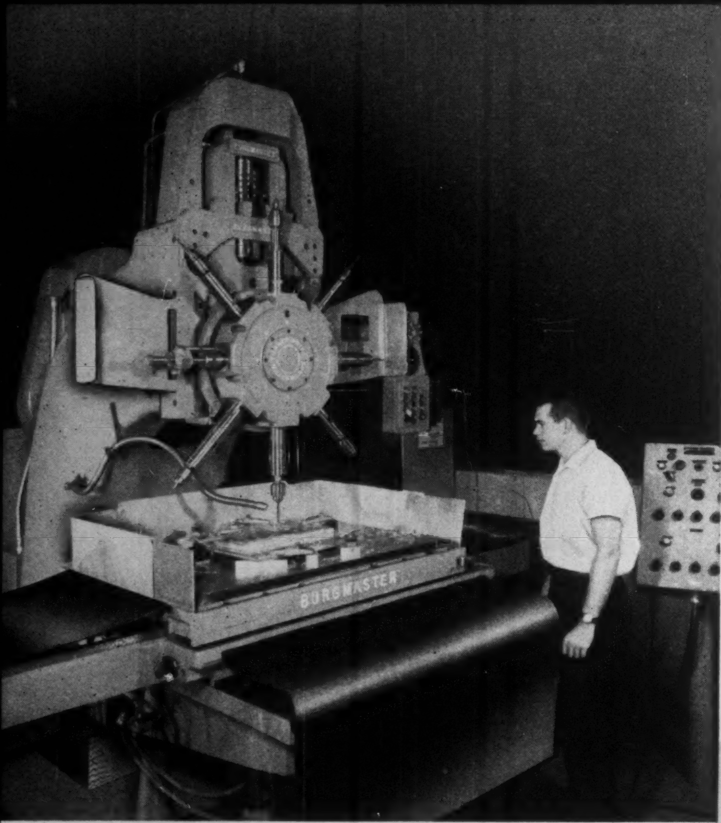
A-F

A-F *ENGINEERED* CONVEYING SYSTEMS
Also Pre-Engineered Conveyors—
Wheel, Trolley, Roller, Belt
Metal Cleaning and Processing Machines

THE ALVEY-FERGUSON CO., 170 Disney St., CINCINNATI 9, OHIO

Circle 666 on Page 19

Tool Savings on Small Lots During
BURGMASTER *tape controlled*



Maximum Flexible Automation---

for Drilling, Boring and Tapping Lots of Any Size

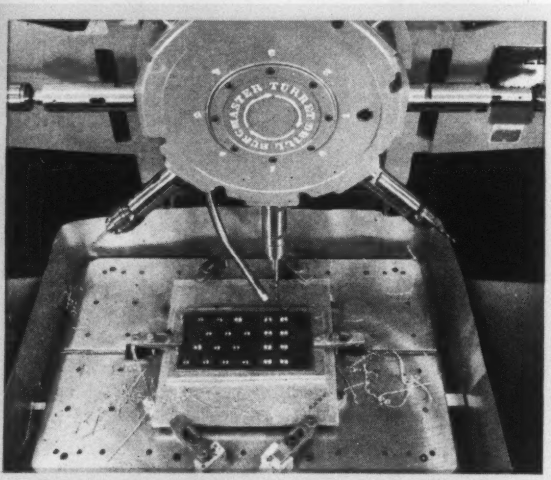
At Rocketdyne, small lots are no limitation for using the automatic Tape Controlled Burgmaster. The fact is, small lots point out the basic advantages of Tape Control for close tolerance hole operations.

- jigs are eliminated and simple clamps are used.
- costly tool room procedures for special tooling is greatly minimized.
- lead time is reduced because of less time to program, prepare a tape, and make a machine set-up.
- surer, faster production is assured because the Burgmaster is automatically tape controlled for fast, accurate machining cycles.
- engineering changes are quickly accomplished by simple tape changes.

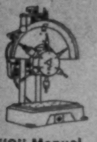
Speed Production, Cut Costs of Experimental or R & D Parts.

Less time, from the drawing board to the finished part—this is the simple formula that works to your advantage when producing lots of any size with the tape controlled Burgmaster Turret Drilling Machine.

268 operations on 100 holes are produced 8 times faster on this Rocket Instrumentation Panel. During machining, one tool change is made on two spindles. Note the simple holding clamps.

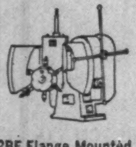


World's Largest Builder of Turret Drilling Machines

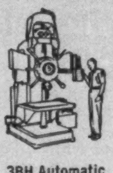

"O" Manual
Power Index
¼" Capacity

1C Manual
Power Index
⅜" Capacity

2B Manual
Power Index
¾" Capacity


2BF Flange Mounted
Power Index
¾" Capacity

2BH Automatic
Hydraulic
¾" Capacity


3BH Automatic
Hydraulic
1½" Capacity

2BR Ram Type
Radial Drill
¾" Capacity

2BHT-3BHT Automa
Tape Controlled
¾" and 1½" Capa

1 Year Will Pay for $68,000.00

8 SPINDLE TURRET DRILL

Tool savings alone will pay for a $68,000 Tape Controlled Burgmaster Turret Drilling, Tapping and Boring Machine within a year, while producing small lots from 3 to 5 parts. In addition, the machine is producing up to 8 times more parts compared to conventional machining methods.

Time is the vital element in producing Research and Development hardware and production at Rocketdyne moves fast in order that parts in process will reflect improvements determined by latest tests. The tape controlled Burgmaster is an answer to getting into production fast and making engineering changes rapidly and inexpensively.

Parts are clamped on the 30″ x 45″ positioning table using an aluminum sub-base and simple clamps instead of expensive tooling with drill bushings. Table positioning is 180″ per minute, being automatically controlled by tape to accurately locate the work on two axis for each setting simultaneously. The tape also controls the selection of proper spindle sequence and all machine functions. In addition, all standard adjustable Burgmaster controls are maintained including pre-selective spindle speeds, infinitely variable pre-selective temperature compensated feeds, selective rapid approach and return.

There is a Burg representative or dealer near you that will supply all the facts — call him at no obligation.

Job Facts

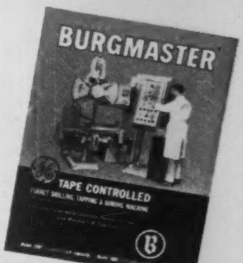
Machine:	Burgmaster 3BHT 8-Spindle Turret Drilling, Tapping and Boring Machine with 30″ x 45″ Positioning Table and GE Tape Controls.
Company:	Rocketdyne, a Division of North American Aviation, Inc., Canoga Park, California.
Part:	Rocket Instrumentation Panel.
Material:	1020 steel plate, ¼″ x 9″ x 18″.
Operations:	Centerdrill and drill 100 holes, tap 68 holes: a total of 268 operations.
Holding:	Standard clamps.
Quantity:	Five parts.
Accuracy:	Table positioning to ±.001″.
Former Method:	Line of single spindle drills using drill jig.
Former Time:	One part per day.
Present Time:	Eight parts per day.
Advantages:	Increased production 8 to 1, lead time drastically reduced, tool saving alone will approximately pay for $68,000.00 Burgmaster Machine within a year.

SEQUENCE OF 268 MACHINING OPERATIONS

Spindle No.	Tool	No. of Holes	Speed	Feed
1	No. 1 Centerdrill	72	2400	.003
4	No. 4 Centerdrill	28	2400	.003
2	.159 Drill	52	1540	.005
6	Tap 10-32NF-3B Tapmatic Head	52	330	.031
7	.136 Drill	16	2400	.003
3	Tap 8-32NC-3B Tapmatic Head	16	330	.031
5	1.06 Drill	10	490	.003
8	.75 Drill	11	770	.003
1*	.406 Drill	7	1200	.004
4	.218 Drill	4	2400	.004

*NOTE: Tools are changed on spindles No. 1 and No. 4 after a programmed machine stop.

Write for Bulletin describing Burgmaster 6 and 8 spindle Tape Controlled Turret Drilling, Tapping and Boring Machines. See Burgmaster Machines in action: Thirty-minute 16mm sound film showing all Burgmaster Turret Drills in operation is available from any Burg office without charge.



BURG TOOL

MANUFACTURING COMPANY, INC.

15001 South Figueroa Street, Gardena, California
FAculty 1-3510 DAvis 9-4158

BURGMASTER DIRECT SALES OFFICES:

Ridgewood, N.J.
86 North Maple Ave.
GIlbert 4-3002

Chicago 25, Ill.
5329 Lincoln Ave.
LOng Beach 1-1178

Cleveland 7, Ohio
14706 Detroit Ave.
ACademy 6-7030

Detroit 37, Mich.
13730 W. Eight Mile Rd.
LIncoln 8-4333

San Francisco, Calif.
1341 Old County Rd.
Belmont, Calif.
LYtle 1-0309

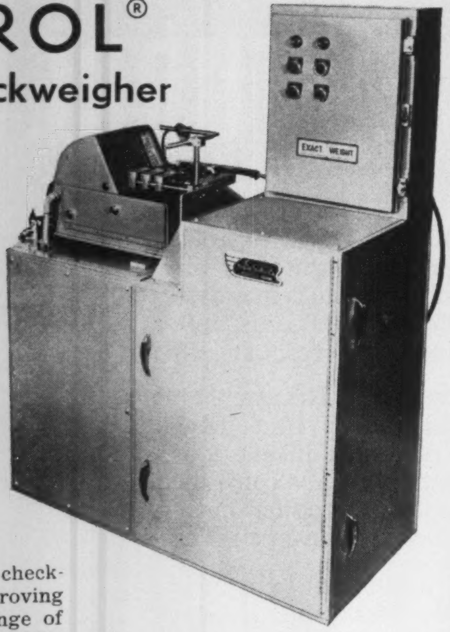
Plus dealer representatives in other industrial centers.

Circle 667
on Page 19

SELECTROL®
Automatic Checkweigher

- WEIGHS
- CLASSIFIES
- SORTS

. . . with unvarying accuracy

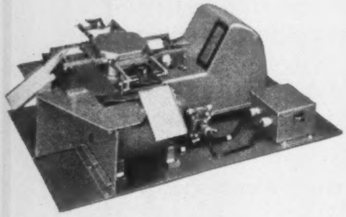


MODEL 145 SELECTROL has in-line "walking deck" type transfer mechanism.

This Selectrol precision checkweigher is capable of proving weight accuracies in the range of 1 part in 5,000 to 1 part in 20,000. Automatic transfer mechanism places commodity on the scale and removes it. Operating speeds up to 60 units per minute depending on capacity and accuracy required.

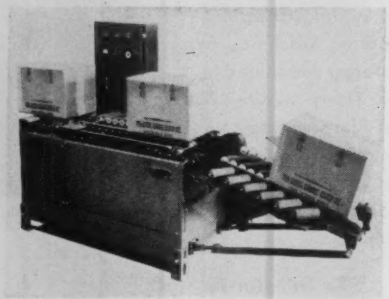
Selectrol employs a Shadograph, an extremely sensitive scale with a light-projection indication system that provides visual readings. Optional accessories include recording, counting, signaling and control devices.

Selectrols are made by Exact Weight, a manufacturer of scales for 45 years and with experience in hundreds of checkweighing installations. Write for Bulletin 3347.



MODEL 144 SELECTROL has rotary transfer mechanism. Automatic selection or rejection is provided immediately following the weigh station.

New Case and Bag Checkweigher



Model 1250 Selectrol, for checking cases, cartons and bags from 20 lbs to 100 lbs., offers accuracy one-tenth-of-one per cent. Speeds up to 30 units per minute. Model shown has over and under weight rejection. Also supplied with underweight rejection only or without rejection mechanism. Optional equipment available for machine control, recording, counting and visible or audible signaling. Write for Form 3280.

THE EXACT WEIGHT SCALE CO.
907 W. FIFTH AVE., COLUMBUS 8, OHIO
In Canada: 5 Six Points Road, Toronto 18, Ont.

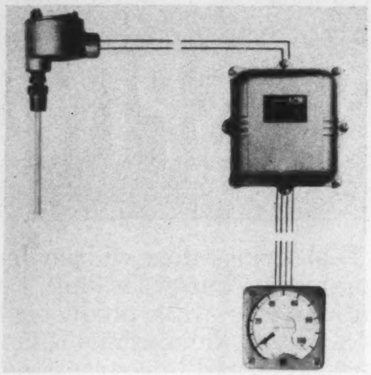
Exact Weight SCALES

Sales and Service Coast to Coast

Find us in your local 'Yellow Pages'

BETTER QUALITY CONTROL . . . BETTER COST CONTROL

Circle 668 on Page 19



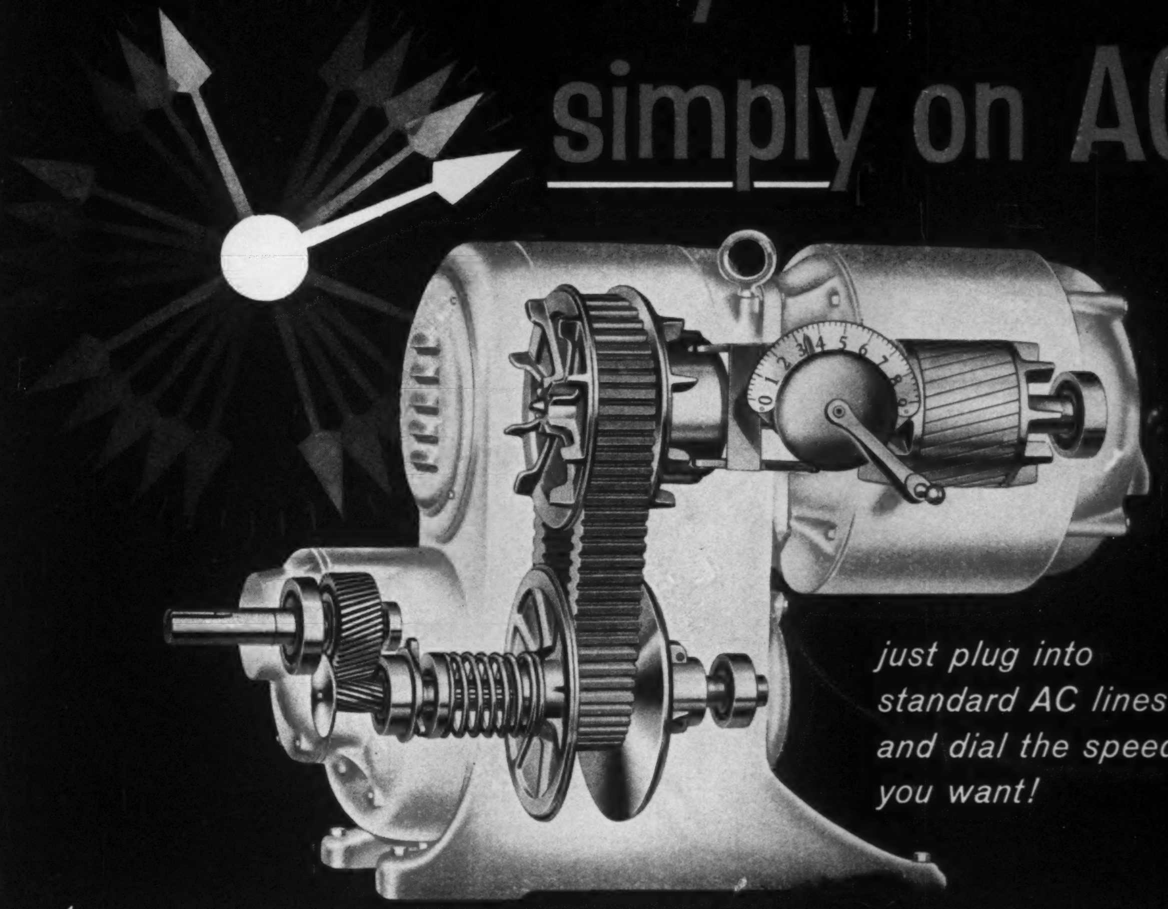
CONTINUOUS indicating level measurement system developed by the Aeronautical and Instrument Div., Robertshaw-Fulton Controls Co., accurately detects, measures, and visually indicates level changes in liquids, viscous fluids, powders, and granular solids. Housed in the probe condulet is a miniature capacitance bridge circuit which is energized by a regulated oscillator in the transmitter. The probe detects media level change as a change in capacitance, unbalancing the capacitance bridge circuit. This out-of-balance condition is fed through the transmitter to the indicator as a dc signal proportional to the level change.

punched cards in the plant office, ready for immediate runs through data processing machines.

The hardware of the new system consists of reporting or input stations on the production line which are similar in size and appearance to a wall-mounted time clock, a control unit which sequentially scans as many as 20 input stations linked to it and connects them to a central output station in the plant office, and a card punch machine which reproduces the input station punched cards. Optional equipment available with the system includes an automatic clock for inserting time data into punched card reports and keyboards at the input stations for transmitting variable data.

Operation of the data collection system is fairly simple. A signal light at an input station shows that it is available for use. An operator inserts two punched cards into the input unit. One card identifies the employee and includes information on employee number, job classification, pay rate, etc. The second card travels with the part or assembly being manufactured and identifies the material on which the operator performs a process step. Additional information can be reported by

any RPM simply on AC!



just plug into standard AC lines and dial the speed you want!

U. S. VARIDRIVE Motors

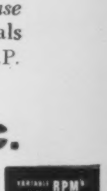
...one unit...infinite speeds!

So *simple* to get any speed you want, directly from standard AC power lines—with U.S. VARIDRIVE MOTORS! One compact, self-contained unit does it. With U.S. VARIDRIVE, you don't have to buy a DC converter, DC generators, complicated and delicate electronic circuits. Just *plug in* this one simple unit—dependable, easy for your regular personnel to maintain. You merely dial, and get smooth, stepless speed changes immediately! Thus, you set speeds for maximum production as needs vary...*increase* machine efficiency...output...product quality! *Decrease* costs...rejects...manpower and materials waste! Available in RATINGS: ¼ to 75 H.P. Specify: "U.S. VARIDRIVE MOTOR."

U.S. ELECTRICAL MOTORS INC.

BOX 2058, LOS ANGELES 54, CALIFORNIA
OR MILFORD, CONNECTICUT

FREE COLOR BROCHURE
...Send for U.S. Varidrive
Bulletin No. 1797



U.S. MAJOR MOTOR LINES INCLUDE:
1. Vertical Solid & Holloshaft, **2.** Varidrive, **3.** Totally-Enclosed, **4.** Uniclosed, **5.** Syncrogear. Also, many other special motors.

Circle 669 on Page 19

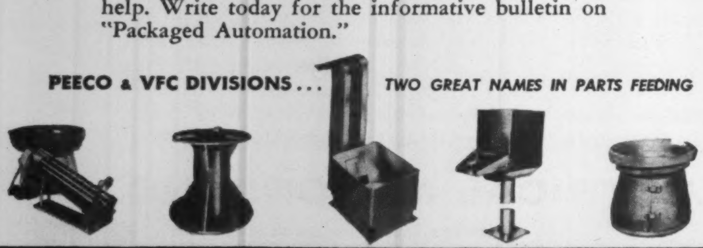
PACKAGED
AUTOMATION!

Achieve efficient, automatic production, and produce more all along the line, by integrating equipment designed and built by AUTOMATION for automation.

For example, vibratory parts feeders perform more efficiently on an engineered base permitting maximum power transmission. Either the side delivery or the elevating conveyor supply hoppers (with automatic paddle type relay switch to regulate delivery) hold large quantities of parts and are real labor savers. These are just a few advantages that make automation work and pay for itself.

You can depend on the proven talents at AUTOMATION DEVICES, INC.—enlist their help. Write today for the informative bulletin on "Packaged Automation."

PEECO & VFC DIVISIONS... TWO GREAT NAMES IN PARTS FEEDING



AUTOMATION DEVICES INC.
ERIE, PENNSYLVANIA

Circle 670 on Page 19

operation of the keyboard.

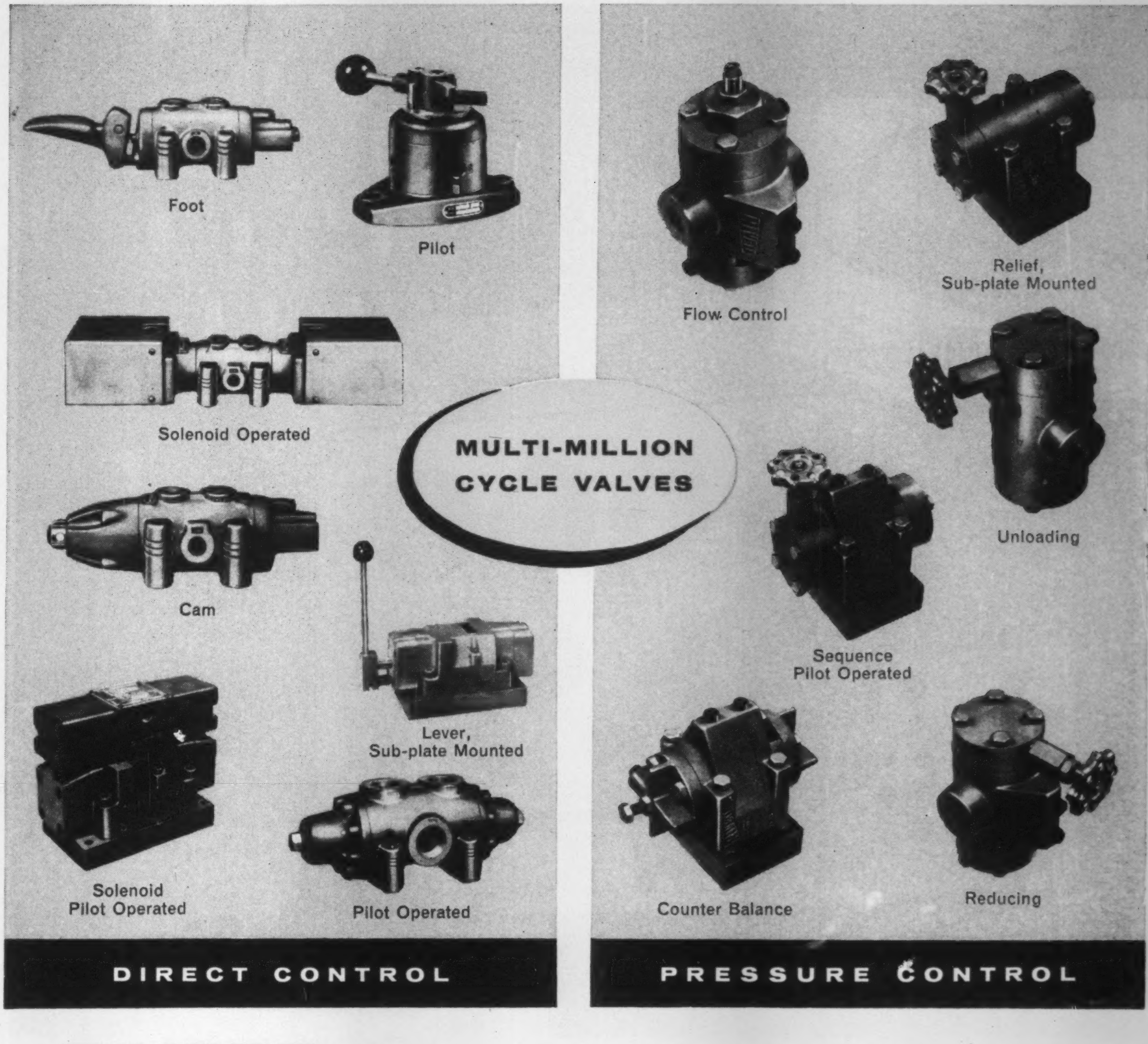
The input control unit sequentially scans the input stations, making a complete circuit in one-third of a second. When it is connected to the particular input station, a signal light flashes that the card is being read and another light signals when the process is completed. The average time for reporting each transaction is less than one minute.

In the plant office, a card punch machine instantaneously creates a new card which duplicates the data on the two input cards. The output card, together with others representing data transmissions from other stations, is then processed through standard electronic equipment which prints out reports for management.

The IBM data handling system can be purchased outright or rented on a monthly basis. Average rental cost of the system, including all associated equipment, is reportedly less than $100 a month per input station.

SPOTLIGHTING PEOPLE

Frederick C. Johnson named vice president and general manager of the Scale Div., Fairbanks, Morse & Co. . . . **O. J. Maha** appointed president and general manager of the Hannifin Co. Div., Parker-Hannifin Corp. . . . **Frank P. Kelly** named manager of manufacturing operations for Brown Instruments Div., Minneapolis-Honeywell Regulator Co. . . . **John E. Ryan** appointed head of a newly formed Internal Automation Operation, a component of the Specialty Control Dept., General Electric Co. The IAO will examine General Electric's operations and recommend where and how greater advantage can be taken of opportunities for automation. . . . **Louis Polk Jr.** named assistant vice president and manager of the gaging and automation systems divisions of Sheffield Corp. . . . **E. S. Mathiesen** appointed vice president in charge of manufacturing for Cutler-Hammer Inc. . . . **Walter B. Claus** named staff assistant to the director of manufacturing for ElectroData Div., Burroughs Corp. . . . **Carra L. Lane** appointed manager of plant operations for Chicago Pneumatic Tool Co. . . . **Leo F. Leary** named to the newly created post of manufacturing manager for


Foot
Pilot
Solenoid Operated
Cam
Lever, Sub-plate Mounted
Solenoid Pilot Operated
Pilot Operated
DIRECT CONTROL
MULTI-MILLION CYCLE VALVES
Flow Control
Relief, Sub-plate Mounted
Unloading
Sequence Pilot Operated
Counter Balance
Reducing
PRESSURE CONTROL

RIVETT... *is the one source for the correct valve, to control all or part of any hydraulic circuit!*

Whatever your requirements, you can find the right valve at Rivett. Save time, money, inventory and maintenance with these most advanced designs. Greater flow capacity; minimum pressure drop; positive damping and operating stability. From single basic assembly of functional valve any one of six functions may be obtained. Over 400 standard models—sub-plate and pipe mounted; direct control and functional. Pressures 1500 and 3000 P.S.I. All actions, all piston designs, all operations. Sizes ¼″ to 2″. J.I.C. standards.

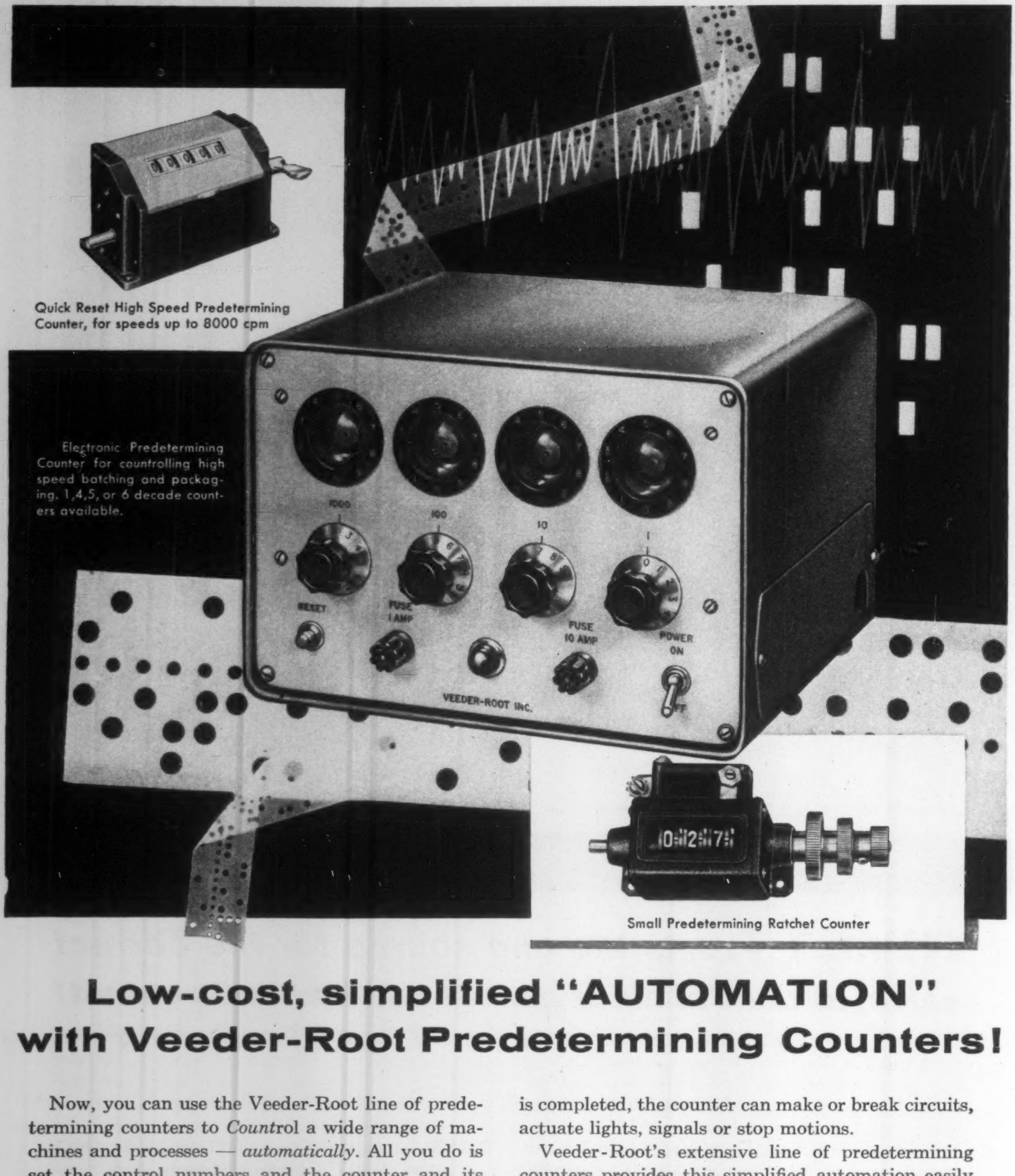
RIVETT LATHE & GRINDER, INC.
Dept. AU11 Brighton 35, Boston, Mass.

The Better You Know Hydraulics—
The Better You Like

RIVETT
HYDRAULIC VALVES

Cat.'s 204, 210, 230 and 261 contain 68 pages describing all valve models, sizes and types with complete working drawings, specifications, performance, ratings, cut-away views. Get free copies today.

Circle 671 on Page 19



Quick Reset High Speed Predetermining Counter, for speeds up to 8000 cpm

Electronic Predetermining Counter for controlling high speed batching and packaging. 1,4,5, or 6 decade counters available.

Small Predetermining Ratchet Counter

Low-cost, simplified "AUTOMATION" with Veeder-Root Predetermining Counters!

Now, you can use the Veeder-Root line of predetermining counters to *Count*rol a wide range of machines and processes — *automatically*. All you do is set the control numbers and the counter and its mechanical or electrical linkage will do the rest.

You can *Count*rol turns, strokes, pieces, lengths, or any other units to a preset sum. When this action is completed, the counter can make or break circuits, actuate lights, signals or stop motions.

Veeder-Root's extensive line of predetermining counters provides this simplified automation easily and at low cost. Attachment to machines and other devices is quick and easy, or a Veeder-Root Counting Engineer can provide application assistance.

Send for NEW folder on Predetermining Counters for additional information; and order from your local **Industrial Distributor** or Veeder-Root Sales Office.

Veeder-Root Inc.

HARTFORD 2, CONNECTICUT

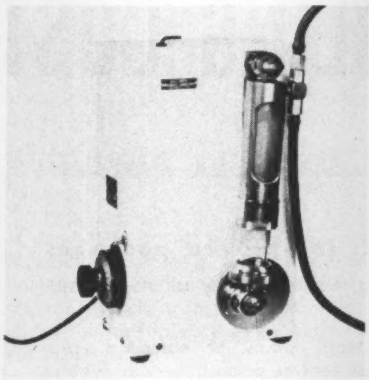
"The Name that Counts"

Chicago • New York • Los Angeles • San Francisco • Seattle • St. Louis
Greenville, S. C. • Altoona, Pa. • Montreal

Offices and Agents in other principal cities

Circle 672 on Page 19

Semiconductor Div., Raytheon Co. . . . **Joseph J. Sousa** named chief engineer and **George C. Zimmerman** appointed director of manufacturing for Electric Specialty Co. . . . **Russell A. Hedden** named works manager of manufacturing, Industries Group, at the West Allis Works, Allis-Chalmers Mfg. Co. . . . **James A. Erdle** joined Servo Corp. of America as facilities planning engineer. . . . **I. O. Johnson** appointed director of industrial and production engineering, Fulton Sylphon Div., Robertshaw-Fulton Controls Co. . . . **Edward C. Lanno** named director of manufacturing services for Saco-Lowell Shops. . . . **Charles J. Stapleman** appointed superintendent of production for Phillips Control Corp. . . . **Ray Lane** named director of research and engineering by Pyramid Electric Co. . . . **Frank P. DeLuca Jr.** appointed executive vice president of Acoustica Associates Inc., and **Fred C. Mehner** named general manager of the Western Div. of the same company. . . . **John W. Murphy** appointed manager of operations for Weston Instruments Div., Daystrom Inc. . . . **Donald C. Duncan** named president of Pacific Electronic Controls Corp., Subsidiary of Royal Indus-



PIPETTING machines manufactured by Baltimore Biological Laboratory Inc. are used in laboratory and industrial applications to automatically dispense measured volumes of many types of fluids. Some examples of industrial uses include dispensing cement used for inserting eyeglass lenses in frames, filling small paint capsules in "do-it-yourself" art kits, dispensing marking pen inks, and dispensing plastic into tubes. In the packaging field, the units are used to dispense oils, lacquers, and aqueous preparations. Available in five basic models, the pipetting machines are useful components for dispensing materials on automatic assembly lines.

POSITIVE FILTRATION

(TO 1/2 MICRON) FOR AS LITTLE AS

.00015¢ PER GALLON!

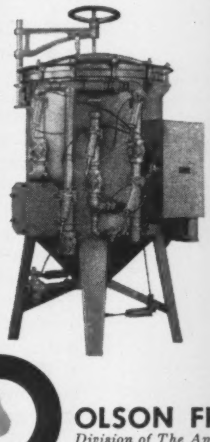
AND IT'S COMPLETELY AUTOMATIC!

Now, from Olson, a new dimension in industrial filtration — the first completely automatic, pressure-type filter! Every cycle — precoat, run, backwash—is automatically controlled. Injection of filter-aid (when used) and sludge carry-out are also automatic.

Maintenance is virtually eliminated in this trouble-free system. No parts to change, no elements to replace, and most important, *no costly downtime for cleaning!*

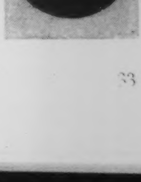
In large central systems, or with individual machines, Olson Filters guarantee over 96% purification of all types of coolants, cutting oils, quenching oils, cleaning and washing solutions and other industrial solvents at the lowest cost per gallon.

By the way, what are *your* costs per gallon? Why not check and see? Then call Olson.



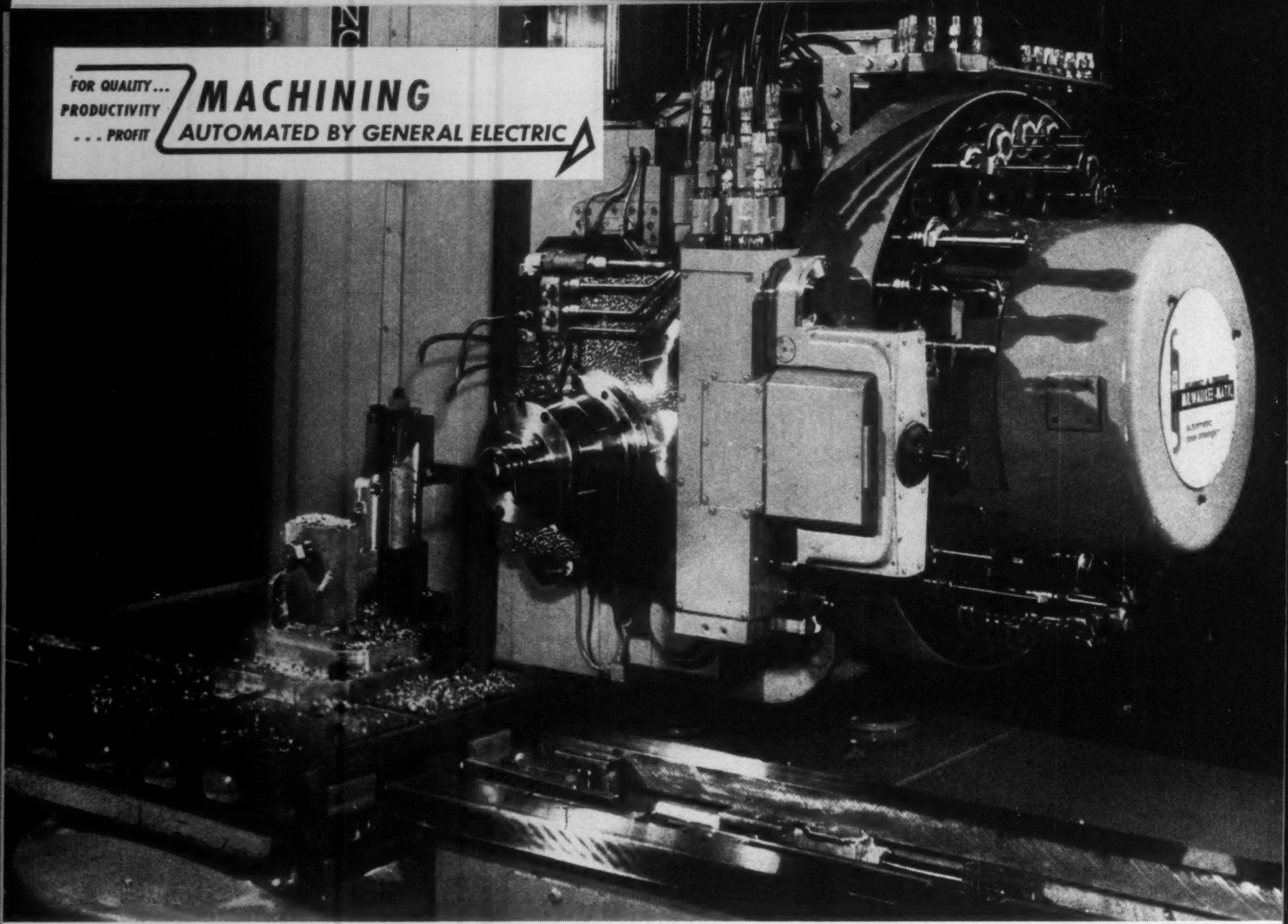
The new Olson Industrial Filter is available in 8 standard models, from 10 gpm to 600 gpm capacities.

Write for free catalog on the new Olson automatic pressure-type filter.



OLSON FILTRATION ENGINEERS
Division of The American Laundry Machinery Company
DEPT. A, CINCINNATI 12, OHIO

Circle 673 on Page 19

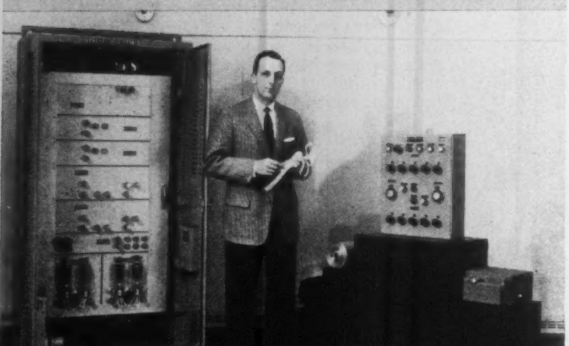


FOR QUALITY...
PRODUCTIVITY
...PROFIT

MACHINING
AUTOMATED BY GENERAL ELECTRIC

ELIMINATE SPECIAL TOOLING COST

MARK SERIES NUMERICAL CONTROLS...

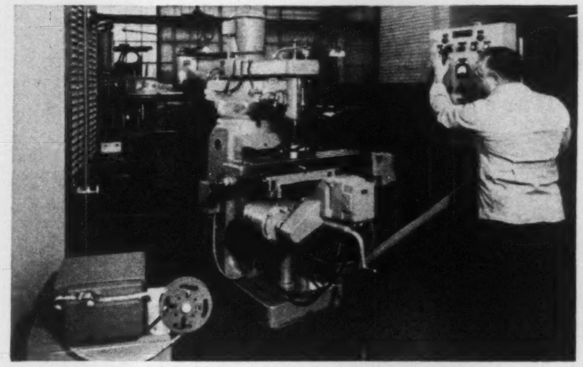


......standard, job-proved packages now in use on a wide variety of machines

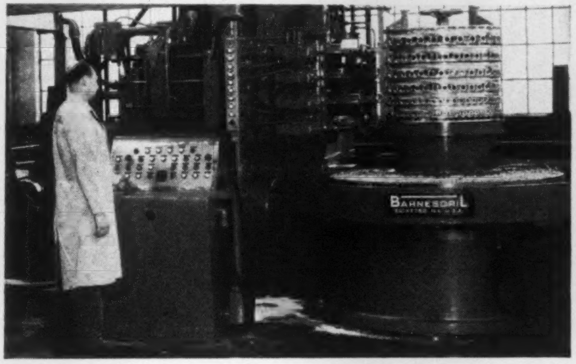
General Electric's Mark series of standard, pre-engineered numerical control packages—with systems for controlling 1 to 5 motions plus machine auxiliary functions — are compiling impressive performance records on scores of machines throughout American industry today.

Machine operation is completely automatic—from punched tape prepared on a standard automatic typewriter. If desired, semi-automatic positioning, useful for prototype work, is obtained with manually set dials on the control station.

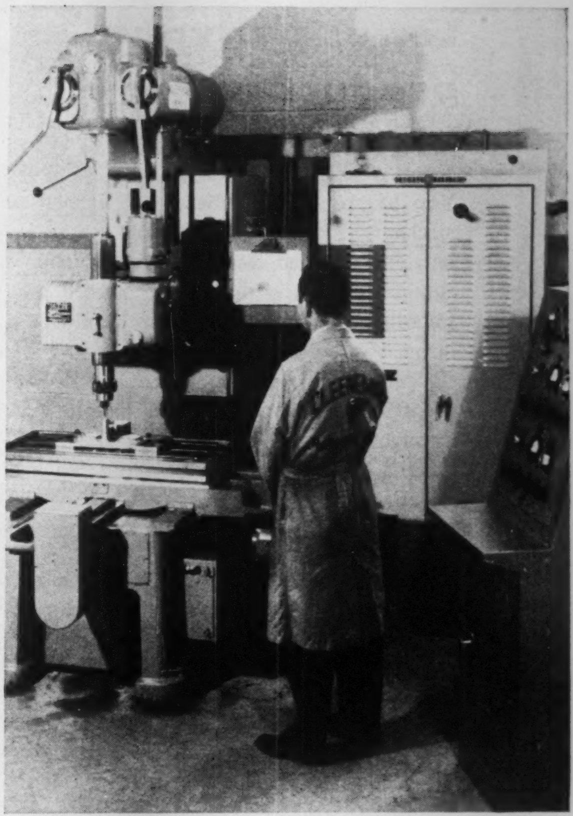
Key components of a typical Mark package are a controller, a punched tape reader, operator's control station, servo drives and position-sensing units.



60-80% LESS FIXTURE COST is average for all new parts produced on this general-purpose milling machine. Tooling expense saving for one part totaled $2000.



TOOLING EXPENSE CUT from $5000 to less than $100; 248 critical holes spotfaced, drilled, bored, counter bored, and chamfered with no jigs or templates.



NO JIGS ARE NEEDED on this G-E controlled layout drilling machine. Tooling cost on one part was reduced from $1350 to $20; $1000 worth of fixtures eliminated on another job.

with General Electric numerical control

Eliminate jigs, cut lead times, save costly tool storage space

A key benefit of General Electric numerically controlled machines is the elimination of special tooling cost in application after application. Reports show jigs, templates, and complex fixtures are absolutely unnecessary—being replaced even in the most intricate jobs by simple holding clamps.

What does this mean to you? It's the end of costly tooling . . . it's shorter lead-time cycles . . . less investment in tool storage and maintenance . . . more flexibility in production scheduling.

Many manufacturers find that savings on tooling costs *alone* will pay for their G-E numerically controlled machines. As an example, on a group of six parts, with a variety of operations performed by a multi-purpose tape controlled machine, tooling savings totaled over $10,000 with cost reductions on a single part from $1890 to $260. With less than 100 such parts, the machine is paid for.

In a routine drilling job, $1300 worth of jigs were replaced with a simple $20 holding clamp.

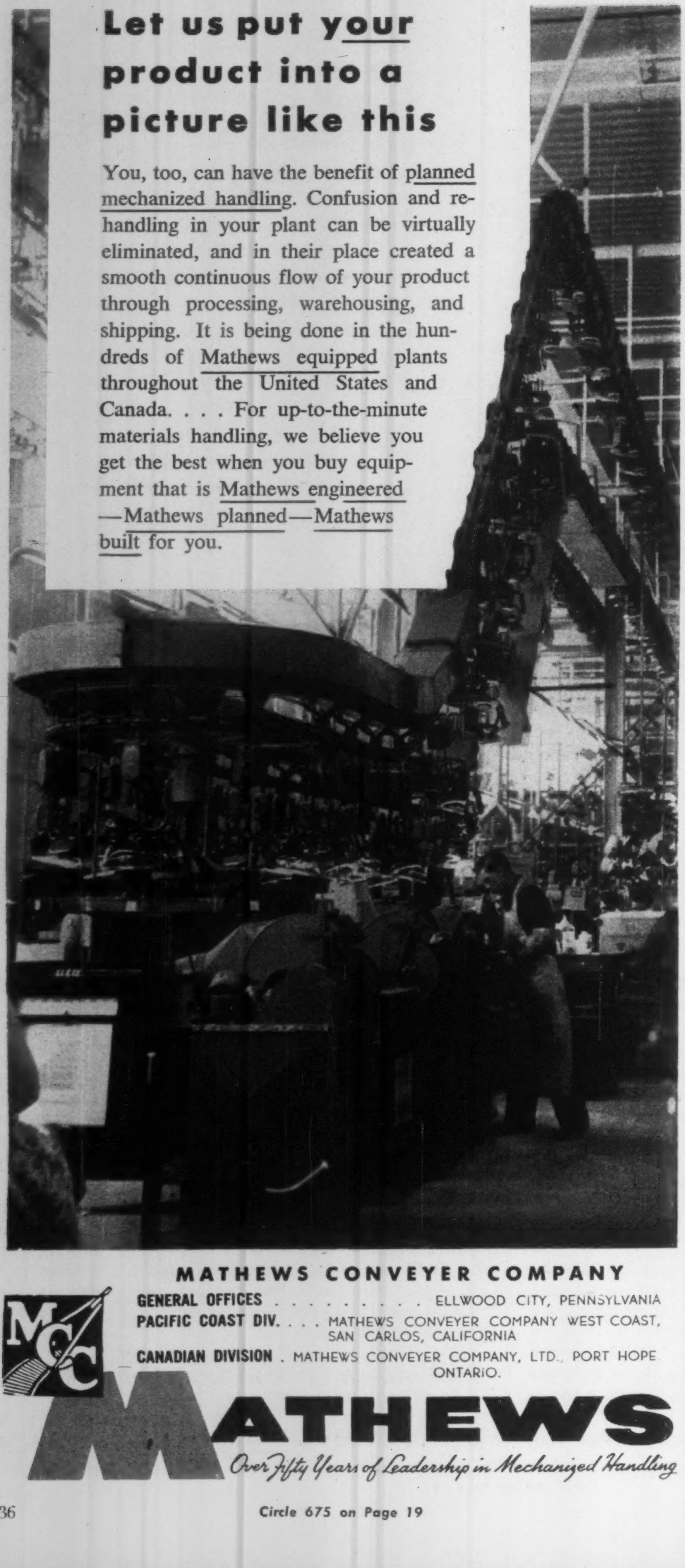
And, another Mark II controlled drill press more than paid for itself in a few weeks. More than 120 different drill jigs—which would have cost $186,000 —were *not* made. These savings alone totaled more than 6 times the original investment in the numerically controlled machine!

Join with the more than a hundred manufacturers who are increasing worker productivity, gaining better product quality, and eliminating special tooling cost with G-E numerically controlled machines. See your G-E Apparatus Sales Engineer or machinery builder today. General Electric Co., Specialty Control Dept., Waynesboro, Va. 795-6

Progress Is Our Most Important Product

GENERAL ELECTRIC

Circle 674 on Page 19

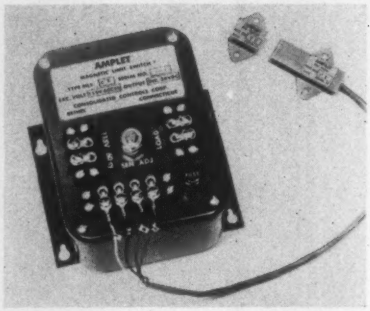

Let us put your product into a picture like this

You, too, can have the benefit of planned mechanized handling. Confusion and rehandling in your plant can be virtually eliminated, and in their place created a smooth continuous flow of your product through processing, warehousing, and shipping. It is being done in the hundreds of Mathews equipped plants throughout the United States and Canada. . . . For up-to-the-minute materials handling, we believe you get the best when you buy equipment that is Mathews engineered —Mathews planned—Mathews built for you.

MATHEWS CONVEYER COMPANY

GENERAL OFFICES . . . . ELLWOOD CITY, PENNSYLVANIA
PACIFIC COAST DIV. . . . MATHEWS CONVEYER COMPANY WEST COAST, SAN CARLOS, CALIFORNIA
CANADIAN DIVISION . MATHEWS CONVEYER COMPANY, LTD., PORT HOPE ONTARIO.

MATHEWS
Over Fifty Years of Leadership in Mechanized Handling



MAGNETIC limit switch developed by Consolidated Controls Corp. has no moving parts and acts on proximity of its two sensing elements. In operation, the probe is connected to the power amplifier and gives an Off signal until a permanent magnet trigger approaches within a predetermined distance which is variable from 0.020 to 0.200 inch. When the probe senses the trigger, the static-type power amplifier is switched to an On signal condition until the trigger has moved away from the probe the predetermined distance. The point at which action takes place is repeatable within 0.001 inch.

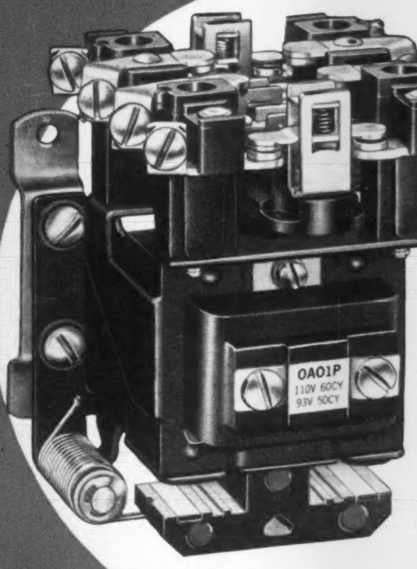
tries Inc. . . . Everard M. Lester appointed director of manufacturing of the Government Products Group, American Machine & Foundry Co.

SPOTLIGHTING PLANTS

Austin Electronics is the new name for the former Special Devices Div. of the Austin Co. The name change was made to reflect more accurately the division's work in the fields of automation engineering, computer application, and advanced electronics research and development. . . . **American Radiator & Standard Sanitary Corp.** is transferring its commercial electronic instrument manufacturing operations from Norwood, Mass., to Detroit, Mich. The Norwood facility being vacated by the Detroit Controls Div. will be used by the Military Products Div. of the company. . . . **Giddings & Lewis Machine Tool Co.** has acquired a substantial interest in a German firm, Nassovia Werkzeugmaschinenfabrik G.m.b.H., located in Langen near Frankfurt am Main. The product line of the German firm is die sinking and profiling machines, transfer machines consisting of rotary chucking automatics, and spark erosion machines. . . . **Wheelabrator Corp.**, manufacturer of airless blast cleaning equipment, dust control equipment, and steel

A New Era
in
Relay Life and Reliability

A-B
QUALITY



NEW

Bulletin 700,
Type B-220A,
AC Control
Relay with
2 N.O. and
2 N.C. contacts.

0A01P
110V 60CY
93V 50CY

NEW

Bulletin 700,
Type BX-440A,
AC Control
Relay can be
wired for
normally open
or normally
closed contacts.

NEW ALLEN-BRADLEY BULLETIN 700 RELAYS

Improved features set new performance standards

For years, Allen-Bradley Bulletin 700 Type B and Type BX relays have been preferred for their long life and trouble free operation. The improvements in the new Bulletin 700 Type B and Type BX relays will set new performance standards wherever they are used. Naturally they use the famous A-B double break, silver alloy contacts which always remain in perfect operating condition without cleaning or filing. The cast coil cannot be damaged by the severest atmospheric conditions.

These new Allen-Bradley Bulletin 700 Type B and Type BX relays offer even greater value and greater reliability than ever before—but the price has not been changed.

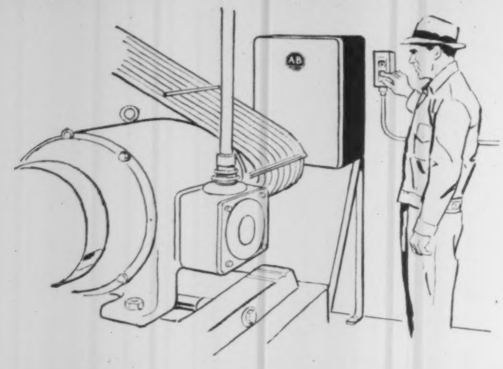
- **New mechanical design gives at least 5 times greater operating life.**
- **New contact motion provides 10 times greater electrical reliability.**
- **Complete interchangeability—mounting dimensions are unchanged.**
- **New hermetically sealed plastic coil fits Bulletin 700 relays presently in use.**
- **New, stronger, movable contact crossbar—also fits old relays.**
- **New reinforced stationary contact blocks—interchangeable with previous design.**

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

9-59-MR

ALLEN-BRADLEY
Member of NEMA

Quality Motor Control

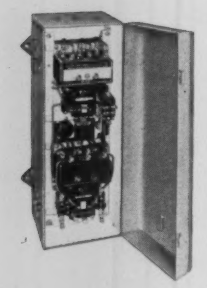


WHEN REDUCED VOLTAGE STARTING IS A MUST

Only Allen-Bradley can provide all the answers

The Allen-Bradley line of reduced voltage starters makes possible a selection of the best starter, not only to meet the power company's requirements but also to provide the best starting conditions for the motor and the "load" that it drives.

The simple solenoid contactors in A-B reduced voltage starters have only ONE moving part—assuring millions of trouble free operations. And their double break, silver alloy contacts never need costly maintenance. Accurate, reliable overload relays protect motors against burnouts. Write for Publication 6088.

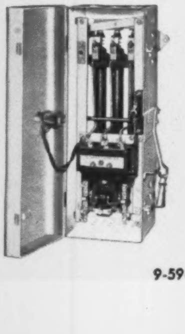


Bulletin 740

Graphite disc resistors are automatically inserted in series with the squirrel cage motor at starting, and they are automatically cut out after a predetermined time. Turning a single screw on the starter frame adjusts the compression resistors exactly to motor and load conditions for velvet smooth acceleration. Ratings to 200 hp, 220-440-550 v.

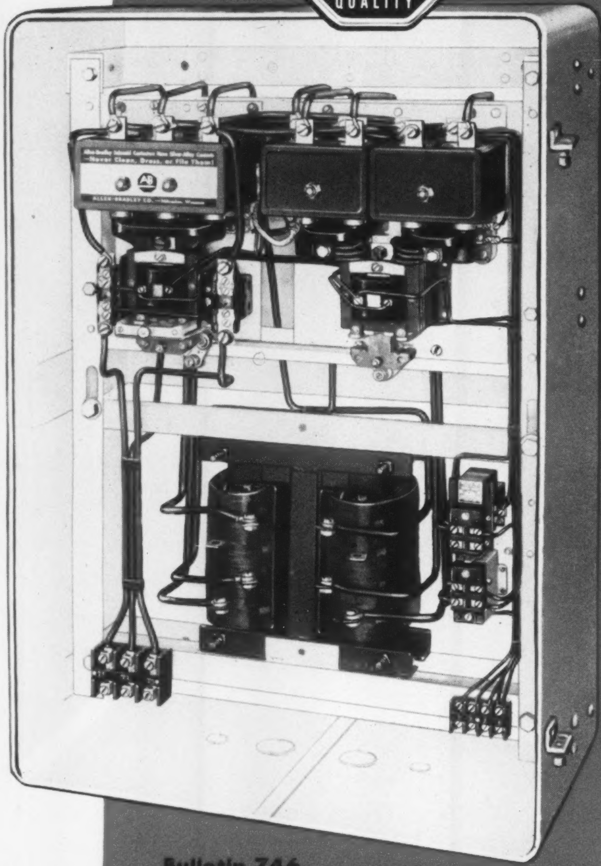
Bulletin 640

Where remote control is not needed, these graphite compression disc resistor starters provide stepless acceleration of squirrel cage motors. Operated by hand lever, the smooth starting of the motor is under the control of the operator. No-voltage and dependable overload protection is provided. Ratings to 200 hp, 220-440-550 v.



9-59-MR

A-B QUALITY



Bulletin 746

Automatic reduced voltage starter for squirrel cage motors that should not be started on full line voltage. It employs autotransformer connected in open delta to reduce line voltage during starting. Adjustable timing relay controls starting period. Taps are provided on the autotransformer to adjust the starting voltage applied to the motor. Ratings to 300 hp, 220 v; 600 hp, 440-550 v.

ALLEN-BRADLEY

Member of NEMA

Quality Motor Control

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

abrasives, has acquired Lake Erie Machinery Corp. Operating as a wholly-owned subsidiary, the new acquisition will continue to manufacture a variety of hydraulic and extrusion presses for metal processing industries, and die casting machines and equipment for the printing industry. . . . **Computer-Measurements Co.,** the electronics division of Pacific Industries Inc., has occupied a new 26,000 sq ft plant in Sylmar, Calif. . . . **Bellows Co.,** division of International Basic Economy Corp., has purchased the Jackson Electronic and Mfg. Co. of Akron, Ohio. The acquisition will permit Bellows Co. to broaden it activities in the field of automation where increasing emphasis is being placed on interlocked electronic, pneumatic, and hydraulic circuits as an aid in reducing production costs. . . . **Michigan Tool Co.** has acquired the assets of Gear Grinding Machine Co. and has established a new Gear Grinding Machines Div. responsible for engineering, manufacturing, service, and sales of gear grinding equipment. All previous activities relating to gear grinding at the former company are being continued by Michigan Tool. . . . **Norden Div., United Aircraft Corp.,** has acquired an 80-acre tract in Norwalk, Conn., on which it will build a multimillion dollar engineering-research and manufacturing facility. Construction of a 350,000 sq ft building is scheduled for completion by next winter.

MEETINGS AND EVENTS

Nov. 4-6—

National Automatic Control Conference. Sponsored by the Institute of Radio Engineers Professional Group on Automatic Control with official participation by the AIEE, ISA, and the IRE Professional Group on Industrial Electronics, meeting will be held at the Sheraton Hotel, Dallas. For further information contact M. L. Barnett, 1095-C Magellan Circle, Dallas 18, Tex.

Nov. 9-12—

National Electrical Manufacturers Association. Annual meeting to be held at the Traymore Hotel, Atlantic City. Additional information

RICHARDSON
PROPORTIONING
SYSTEMS

You can automate from bin to batch with Richardson equipment

Whether your requirements are large or small, a Richardson Select-O-Weigh automatic proportioning system offers you the advantages of – 1. Savings in labor costs. 2. Increased productivity. 3. Quality control. 4. Better housekeeping. 5. Permanent printed records. Incorporated into and governed by a Select-O-Weigh System are such units as –

Feeders – Designed to handle your material quickly and quietly – hundreds in use on all kinds of products.

Scales – Richardson Automatic Scales are known for speed and dependability. Any number can be remotely controlled by a Select-O-Weigh system.

Controls – Program your production and processes by punched card, formula board, formula capsule or weight-selector verniers. Only Richardson offers all four. Control is from a single electronic panel board, operated by one man. No special training is required.

Readout–Richardson furnishes counters, totalizers, printers, typewriters and recorders of all types.

Richardson's nationwide network of service facilities is at your disposal within 24 hours if required. Likewise, Richardson helps you at start-up of your system and thoroughly checks it in operation. For full details on how you can automate your processing with Richardson equipment, write or call today. 1791

Richardson Scales conform to U.S. Weights and Measures H-44 for your protection.

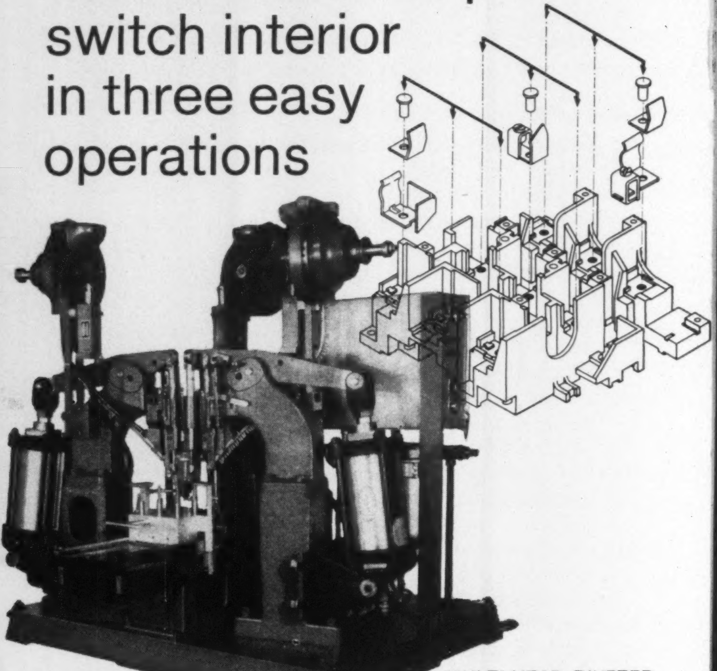
Here's the answer . . .

Richardson
MATERIALS HANDLING BY WEIGHT SINCE 1902

RICHARDSON SCALE COMPANY • CLIFTON, NEW JERSEY
Sales and Service Branches in Principal Cities • Also manufactured in Europe to U. S. Standards.

BOTH
MADE
ASSEMBLY
MORE
AUTOMATIC
with
the help
of
TRS
PAR PROCESS
riveting
engineers

GENERAL
ELECTRIC
assembled a 25-part
switch interior
in three easy
operations



MULTI-HEAD RIVETER

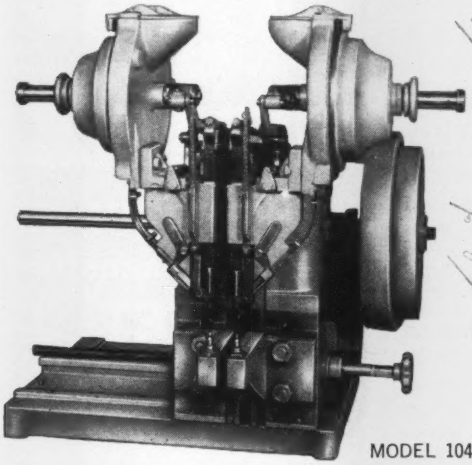
Assembling interior components of the new G.E. Safety Switch required nine riveting operations, fastening twenty-four components to a complex molded base. Engineers from G.E. and TRS worked together in planning the assembly steps and in designing this Multi-Head Riveter to accomplish them. All components are loaded on a TRS-designed fixture which is equipped with a cam-operated hold-down and a 3-position stop mechanism. Sliding the loaded fixture forward to the first stop, the riveter is tripped to set three rivets at one time. At the second and third stops, two more groups of three rivets are set to complete the assembly. Withdrawing the fixture causes the hold-down to open, permitting removal of the work.

TRS

TUBULAR RIVET & STUD COMPANY
Quincy 70, Mass.

TRS SALES OFFICES: Atlanta • Buffalo • Charlotte • Chicago • Cleveland
Dallas • Detroit • Hartford • Indianapolis • Los Angeles • New York
Philadelphia • Pittsfield • Quincy • St. Louis • Seattle.
WAREHOUSE IN CHICAGO See "Yellow Pages" for phone numbers

ROYAL McBEE saved almost $20,000 in their Royal Electric typewriter assembly



MODEL 104 RIVETER

Original production plans called for the use of solid rivets and a spinning machine, to put together a subassembly for the Royal Electric typewriter. Countersunk holes were required. Also, transferring the loose assembly to the fastening position offered many opportunities for scrap-making fumbles. The TRS engineer suggested replacing the solid rivets with semi-tubular rivets, not requiring countersunk holes, and automatically fed and set with standard TRS Model 104 riveters. A special loading fixture was designed by TRS, to receive the components and remove any chance of fumbles. Within a relatively short period of time, almost $20,000 was saved through a marked increase in production efficiency plus the virtual elimination of rejects.

FIND OUT what TRS PAR PROCESS can save you!

PAR stands for **P**roduction **A**utomated **R**iveting. It is the process through which TRS applies Automation to assembly by integrating and making more automatic operations like:—

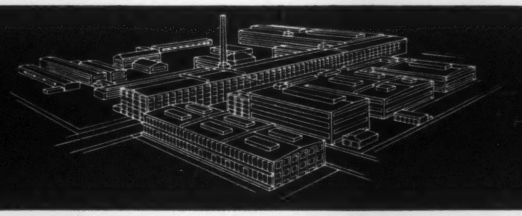
1. FEEDING of tubular rivets or related products.
2. TRANSFER of parts to — or between — riveter stations.
3. SEQUENCING from 3 to 15 rivet setters to operate simultaneously or in any desired order.
4. CONTROL of setting force as required by parts thickness or material characteristics.
5. SENSING of improper conditions and stopping equipment to avoid injury to parts, equipment, or operator.
6. EJECTION of parts as required.

To design the integrated system of standard or multi-head riveters, feeders, transfers and controls required by the TRS PAR Process demands the special knowledge and experience which TRS possesses in greatest measure.

TRS not only originated tubular rivets, but also the revolutionary multi-head riveter which opened up new possibilities for automating the riveting process.

Invite a **TRS** Engineer to Check Your Assembly Operations

If your product can be riveted, and especially if several rivets are involved, it's practically certain that TRS can help you increase production rates, save on direct labor charges, decrease parts spoilage and machine down time. To investigate, just write or phone the nearest TRS office.

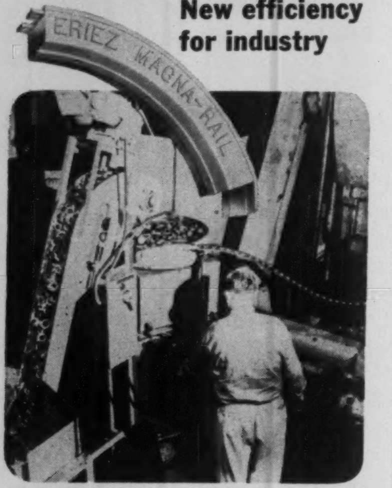


The more automatic you make your riveting

. . . the more important it is to use TRS Rivets

MAGNETS
PLUS
AUTOMATION
EQUALS
MAGNAmation®

New word from
ERIEZ
New efficiency
for industry



MAGNA RAILS. Lifetime powered, non electric magnetic elements that convert ordinary belt conveyors to *magnetic* conveyor elevators. Will convey ferrous items up inclines as steep as 90° — quickly, safely, with positive hold. Easily installed under existing lines, or incorporated into new equipment. Increases production. Reduces manpower needs. Saves valuable factory floor space.

VERSATILE MAGNA RAILS ARE AVAILABLE IN MANY MAGNETIC STRENGTHS IN VARIOUS BOLT-TOGETHER LENGTHS AND IN STRAIGHT AND CURVED SECTIONS, ASSURING YOU PROPER UNITS FOR SOLVING YOUR HANDLING PROBLEMS REGARDLESS OF SIZE OF PARTS.

MAGNETS
for
AUTOMATION

We work closely with design engineers, OEMs, etc. Contact us any time.

FREE! Comprehensive "Belt Conveyor" portfolio. Complete info on magnetic components, applications, test data, installation photos, etc. Write today to Eriez Manufacturing Co., 119-YA Magnet Dr., Erie, Pa.

ERIEZ

Circle 679 on Page 19

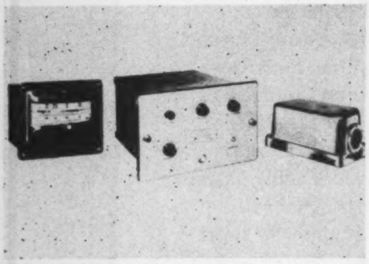
is available from Russell Gingles, NEMA, 155 E. 44th St., New York 17, N. Y.

Nov. 11-13—
Operations Research Society of America. Sixteenth national meeting to be held at the Huntington-Sheraton Hotel, Pasadena, Calif. For further information, Sidney I. Firstman, Rand Corp., 1700 Main St., Santa Monica, Calif.

Nov. 16-18—
Packaging Institute. National Packaging Forum to be held at the Statler-Hilton Hotel, New York. Additional information is available from Charles A. Feld, Packaging Institute, 342 Madison Ave., New York 17, N. Y.

Nov. 17-20—
Packaging Machinery Manufacturers Institute. National exposition to be held at the Coliseum, New York. Additional information is available from Hanson & Shea Inc., One Gateway Center, Pittsburgh 22, Pa.

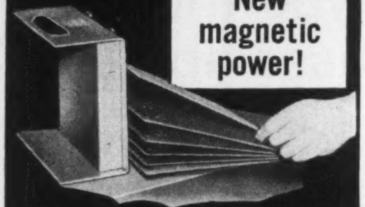
Nov. 29-Dec. 4—
American Society of Mechanical Engineers. Annual meeting to be held at the Chalfonte-Haddon Hotel, Atlantic City. For further information contact ASME headquarters, 29 W. 39th St., New York 18, N. Y.



RADIATION thermometer developed by Radiation Electronics Co. measures and controls temperature of moving or stationary objects without physical contact. System shown consists of a rack-mounted indicating controller, power supply, and a hermetically sealed optical head. The thermometer operates on the principle that an object emits thermal, or infrared, radiation as a function of its temperature. Radiation from the object is received by the optical head, translated into a signal voltage, and amplified to a voltage sufficient to drive an indicator which is calibrated directly in temperature. Standard temperature ranges available with the instrument vary from 180-400F to 700-2000F.

FOR
FANNING
HARD-
TO-HANDLE
SHEETS

New design!
New
magnetic
power!



ERIEZ
HI-POWR
Ceramic magnetic
SHEET
FANNERS

NOW AVAILABLE FOR IMMEDIATE DELIVERY ON MOST MODELS!

Strongest sheet fanners made! New magnetic circuit design gives stronger, snappier fanning action for semi-sticky, bent and heavy-gauge sheets. Increases production . . . greater safety factor . . . saves manhours . . . eliminates marred surfaces and "doubles". For sheets up to 1/8" thick, stacked up to 14" high.

Marked improvement in handling heavier sheets — up to .125" thick • Enclosed, embedded magnetic circuit is tamperproof, rugged • Stainless steel U-frame construction • Easily fastened to any flat surface.

GET COMPLETE DETAILS. WRITE TODAY TO: Eriez Mfg. Co., 119-YB Magnet Drive, Erie, Pa.

ERIEZ

Circle 680 on Page 19

AUTOMATIC packaging machine forms oriented styrene sheets into plastic trays without the application of heat or adhesives. The machine was developed by R. A. Jones & Co. Inc. in co-operation with Monsanto Chemical Co., Charles E. Palmer & Associates, and Plax Corp. The integrated development program by a machine manufacturer, a resin producer, a machine developer, and a material supplier is believed to be the first of its kind in the packaging industry. The machine cold-forms and locks unscored die-cut plastic blanks into trays at speeds of 40 to 100 per minute, depending on package size and dimensions. During the automatic folding operation, the blank is confined to prevent cracking or crazing. After release, the plastic resumes its stability and holds the tray fold in a tight closure.

Nov. 30-Dec. 4—

Exposition of Chemical Industries. 27th biennial exposition to be held at the Coliseum, New York. Additional information is available from the International Exposition Co., 480 Lexington Ave., New York 17, N. Y.

Dec. 1-2—

Marquette University College of Engineering. Fourth Midwest Symposium on Circuit Theory to be held at Marquette University, Milwaukee, Wis. Additional information is available from Stanley Krupnik Jr., Electrical Engineering Dept., Marquette University, Milwaukee 3, Wis.

Dec. 2-4—

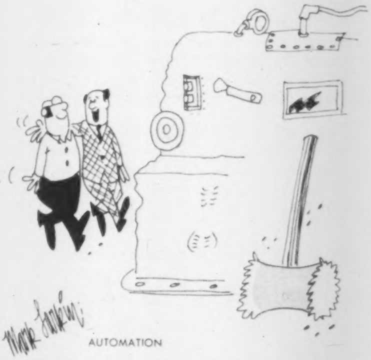
National Association of Manufacturers. Congress of American Industry to be held at the Waldorf-Astoria Hotel, New York. For further information, contact Charles R. Sligh Jr., NAM headquarters, 2 E. 48th St., New York 17, N. Y.

Dec. 6-10—

American Institute of Chemical Engineers. Annual meeting to be held at the Sheraton Palace Hotel, San Francisco, Calif. Additional information is available from F. J. Van Antwerpen, AICE headquarters, 25 W. 45th St., New York 36, N. Y.

Dec. 13-16—

Material Handling Institute Inc. Annual meeting to be held at the Savoy-Hilton Hotel, New York. For additional information, contact John M. Neeson, Hanson & Shea Inc., One Gateway Center, Pittsburgh 22, Pa.

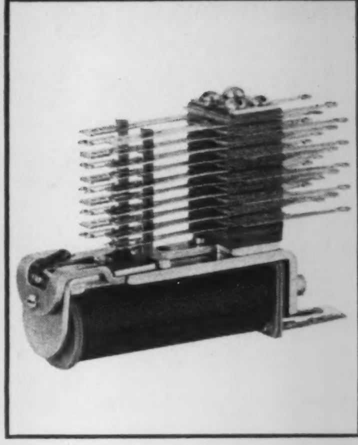


"You've kept this machine running when everyone else failed, Jones. What's your secret?"

Stromberg-Carlson

"TELEPHONE QUALITY"

Relays



. . . featuring new high-voltage types for test equipment or other high-voltage applications.

THE insulation in the new relays withstands 1500 volts A.C.—3 times normal. These high-voltage models are available in Types A, B and E. They are the latest additions to the Stromberg-Carlson line of twin contact relays—all available for immediate delivery.

The following regular types are representative of our complete line:

Type A: *general-purpose relay with up to 20 Form "A" spring combinations. This relay is excellent for switching operations.*

Type B: *a gang-type relay with up to 60 Form "A" spring combinations.*

Type BB: *relay accommodates up to 100 Form "A" springs.*

Type C: *two relays on the same frame. A "must" where space is at a premium.*

Type E: *has the same characteristics as the Type A relay, plus universal mounting arrangement. Interchangeable with many other makes.*

Complete details and specifications are contained in our new relay catalog, available on request. Write Stromberg-Carlson Telecommunication Industrial Sales.

STROMBERG-CARLSON
A DIVISION OF **GENERAL DYNAMICS**
111 CARLSON RD. • ROCHESTER 3, N.Y.

Circle 681 on Page 19

WEATHERHEAD

fittings and hose assemblies

"MADE BETTER TO SERVE BETTER"

brass FITTINGS

⅛" to 1" sizes for pressures up to 5000 p.s.i. Approved by U.L., A.G.A., A.S.M.E., A.S.A. and S.A.E.

S.A.E. 45° Flare
Compression
Selfalign®
Threaded Sleeve
Inverted Flare
Pipe

forged steel FITTINGS

For flare and flareless pressure connections. Sizes ⅛" to 2" in carbon or stainless steel for pressures to 10,000 p.s.i.

Ermeto
Flare-Twin
S.A.E. 37° Flare
Pipe

bulk hose

Twenty different styles available. From ¼" to 2" O.D. for working pressures up to 10,000 p.s.i.

hose assemblies

Completely fabricated with permanently attached swaged ends. Any size, any quantity for working pressures up to 10,000 p.s.i.

reusable hose ends

Designed for fast assembly and positive, leak-proof performance under high pressures.

tube working tools

Designed for fast, accurate fabrication of all types of tubing layouts.

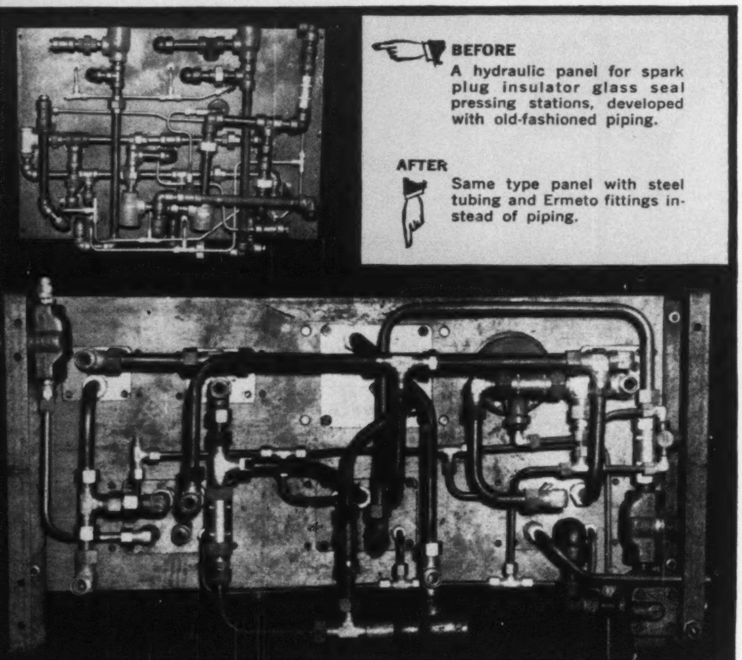
Tube Cutters
Tube Bending Springs
Mechanical Benders
Flaring Tools
Swaging Tools

Write for new general catalog—contains complete data and specifications for all items.

Screw machine parts made to your specifications . . . any machinable material. Write for information.

AWARD WINNING IDEAS . . .

"Ermeto Fittings Save $2000 Worth of Maintenance Labor Annually"



BEFORE
A hydraulic panel for spark plug insulator glass seal pressing stations, developed with old-fashioned piping.

AFTER
Same type panel with steel tubing and Ermeto fittings instead of piping.

Idea submitted by:
William T. Bayley
A.C. Spark Plug Division, G.M.C.
Flint, Michigan

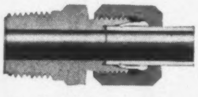
The photographs above show *before* and *after* views of hydraulic panels for a spark plug insulator assembly application which uses a petroleum base fluid operating under 700 p.s.i. at 115°F. Six machines were originally piped as shown in the *before* photograph. As Mr. Bayley states, "Considerable leakage at the many pipe threads was encountered, resulting in frequent maintenance. Oil leakage of these *before* units eventually resulted in operator injury.

"The *after* photograph shows one of the six panels repiped with Ermeto fittings and steel tubing. The results have been a 100% reduction of maintenance and oil leakage, reduced turbular flow, with a much neater installation operating at smoother and cooler rates.

"Ermeto fittings were selected because they were proved best from our tests. The superior grip on the tubing by Ermeto fittings survives shock and vibration, resulting in fewer leaks and less maintenance.

"The savings in maintenance of the six units *after* repiping amounts to approximately $2000 a year. This is chiefly in labor."

Find out how Ermeto fittings can help you reduce maintenance costs and improve system efficiency . . . *write today.*



Ermeto hydraulic fittings are unmatched for positive high pressure control. Available in stainless or carbon steel with "Weathercote" or Cadmium finish in ¼" to 2" sizes.

BRASS & STEEL FITTINGS / HOSE & ASSEMBLIES / TOOLS & ACCESSORIES

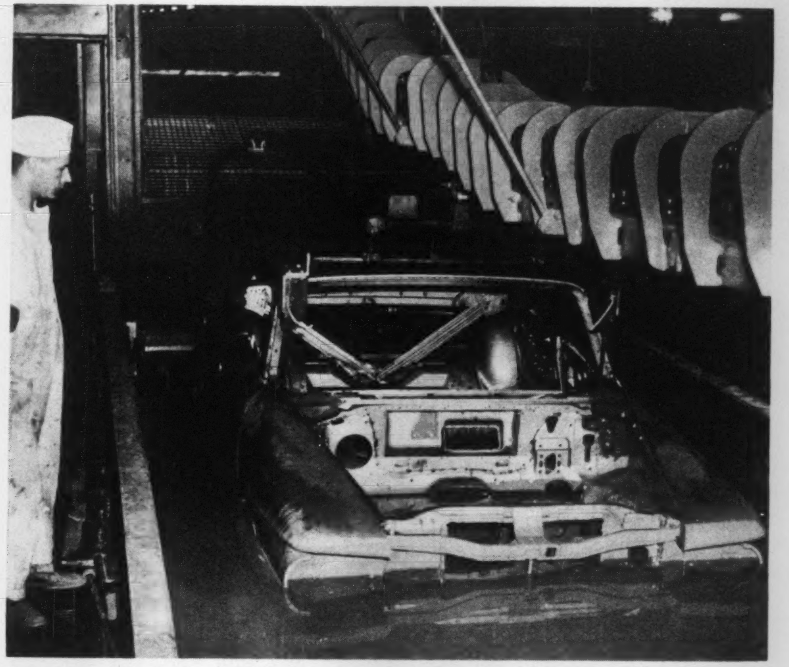
WEATHERHEAD

THE WEATHERHEAD CO., FORT WAYNE DIVISION
Dept. A-11, 128 W. Washington Blvd., Fort Wayne, Ind.
In Canada:
The Weatherhead Co., Ltd., St. Thomas, Ont.

Circle 682 on Page 19

detroit dateline

By JAMES C. KEEBLER Managing Editor



Body of a Chrysler Corp. car is seen here entering the primer bath, which coats the entire lower body up to a height of 18 inches. Operation is part of new anti-corrosion, rustproofing process used on the company's new models.

Wanted By the Public

SHOWROOMS full of new models are a glittering testimony that Detroit is out to give the motoring public what it wants. Since no one particular four-wheeled vehicle can possibly satisfy the multiplicity of individual buyers' tastes, the offerings for 1960 include a wide choice of sizes, shapes, and appurtenances.

Understandably the giants of the industry have never catered to the oddball market, but make their money by selling popular cars. The popularity potential of an oddball idea is a perplexing problem to ponder. The designer of the product line needs to know what the public wants, and this question is not simply answered. What share of how big a market will be taken by *Economy Car* sales is still a crystal ball guess.

Responsibility Split

Because of the split responsibility between those who design cars and those who design production systems that make cars, the type of merchandise offered to the public is the prime responsibility of the product designer and not the manufacturing engineer. However, those who earn their bread and butter as manufacturing engineers have a moral responsibility to assist the product designer by devising new or improved production techniques that can produce a better product.

Overspecialization in these essential engineering areas can lead to the ingrown attitude, "So long as we make the parts to their prints —that's all that we're supposed to do." The dedicated automakers cannot afford such an attitude and are always on the prowl for ways to make it better.

One area of customer preference that is clearly defined has a not-so-clearly defined specification responsibility. The paint job on the new jalopy must be better than what the public has had. Rusted rockers and corroded bodies are unsightly and out of character with the dependable durability promised by the salesman.

By a strait-laced split of the responsibility the product designer can specify that the body be of sheet metal and be painted for beauty and protection. The manufacturing engineer can in turn specify a system that paints it to specs. If the elements of nature (particularly in the lands of ice, snow, and road salting operations) eat holes in the gleaming vehicle, who's to blame? An incensed populace choruses "Detroit," and tells each other old wives tales like the 100 mile per gallon carburetor story: to wit: "Detroit knows how to do it but they refuse because of a greed complex that industrial giants have with respect to customer's pocketbooks."

Where is the molded plastic body that's impervious to everything? Where's the stainless steel body? Where's the aluminum? Where's the durable paint? The answer seems to be that all these things are available, but not at a price you'd be willing to pay. Here's where the manufacturing engineering function looms large in the solution. By devising techniques of obtaining the desired result at the right price, the industry establishes faith in the conviction that automakers are out to give the public what it wants.

Although the finish that is applied to the body may be a part of the product specification, how that finish is applied can be considered a process specification. Yet, as in so many chemical reactions, the qualities of the resultant product are so intimately dependent upon

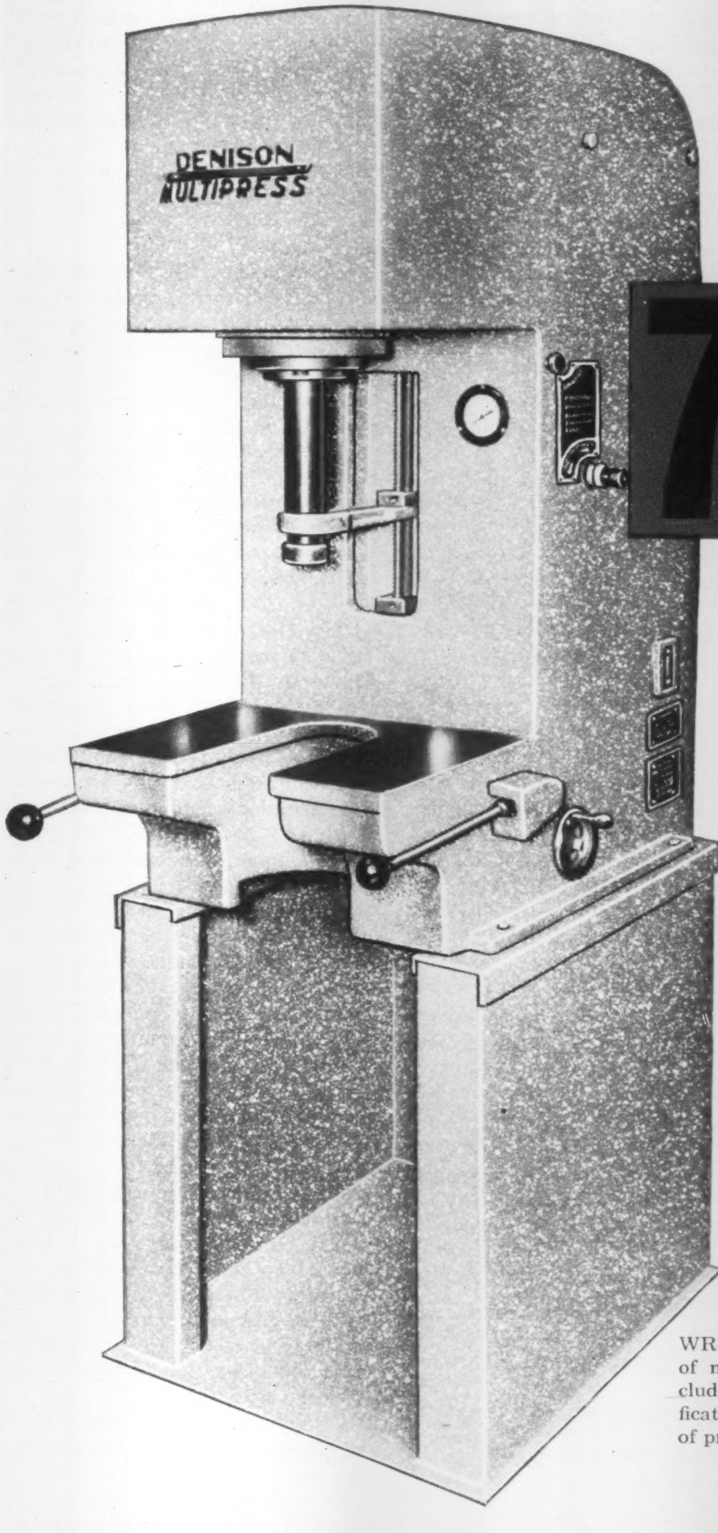
Announced by DENISON

NEW SERIES OF COST REDUCING HYDRAULIC MULTIPRESSES

Denison, Denison HydrOILics, and Multipress are registered trademarks of Denison Eng. Div., ABSCO

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

DENISON HydrOILics
TRADE MARK



PACING THE PRESS INDUSTRY WITH...

7 major advancements made on an already efficient producer

NOW STANDARD ON THE NEW SERIES "R", "S" AND "T" bench-type presses to cut costs in even your toughest production job.

PRODUCES MORE PIECES-PER-HOUR ... 65% faster approach. Faster return speeds on the hydraulic ram give you more cycles-per-minute.

FASTER TO SET-UP ... new, quick, simple adjustment now sets position of ram in seconds. And you can "inch" the ram to the work under set pressure. Closer control of ram pressure is quickly attained with a newly developed relief valve.

SIMPLER TO TOOL ... there's more daylight to mount tools for manual or automatic production.

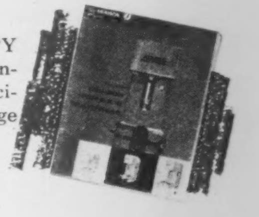
HANDLES WIDER RANGE OF WORK ... ram stroke has been doubled for greater tool clearance for long, deep work.

EASIER TO OPERATE ... there's more knee room for operator's convenience.

SIMPLER TO MAINTAIN ... complete motor and pump swing out of position to inspect and service the hydraulic system.

BUILT TO J.I.C. STANDARDS

WRITE FOR YOUR COPY of new Bulletin 324 ... includes application and specification data on wide range of production jobs.



DENISON ENGINEERING DIVISION **American Brake Shoe Co.**
1234 Dublin Road • Columbus 16, Ohio
Denison Stocking Branch Offices: LOS ANGELES • HOUSTON • CHICAGO • DETROIT • ATLANTA • NEWARK • CLEVELAND

the conditions that prevail in the process that the responsibility of product and process specification cannot be completely split.

Complex Problem

An inside look at the complexity of changing materials in the finishing process was given to the SAE by Walter Mitchell, Fisher Body's general administrator, Paint Standards Activity. Speaking on the adoption of acrylic lacquer for all General Motors passenger cars, Mitchell said they had been experimenting with acrylics over ten years.

Refinements of formulations and tests required proving on Florida weathering evaluation racks, trial on a few company cars, a limited number of production cars, then finally to the stage of 100 per cent conversion of facilities.

General Motors has 24 body assembly plants. Of these, 17 are Fisher Body plants and 7 are for Buick - Olds - Pontiac production. Any new system or new material adopted must work satisfactorily in all 24 body producing plants, in widely scattered geographical areas differing in temperature, humidity and other climatic conditions. In addition to the number of installations to consider, the quantities involved are a big factor. With a production of fifteen thousand cars a day, an error in processing or materials that might lead to paint failure could be disastrous.

In just the equipment alone a large volume of paint is involved. Mitchell says that Fisher Body plants have 225 miles of pipelines circulating paint; 48,000 gallons of paint are required to fill the lines. Add another 51,000 gallons for the mixing tanks and there's almost 100,000 gallons of paint required just to get ready for production. Small wonder they don't make changes lightly or without long consideration and experiment.

Revised Facilities

Although the magic of acrylic lacquer has such gloss-retention properties that it is said to make waxing and polishing unnecessary, it involves added complications with respect to its production application to the car. Because the new paint settles out very rapidly, the recirculating systems that keep paint flowing between spray booths and mixing tanks required revision.

Formerly when a spray gun was not in use a length of line from the circulating pipe to the gun represented a "dead end" in which the paint would settle out. Such facilities were adequate for nitrocellulose lacquer, but for faster settling acrylic it was necessary to equip each gun with a small diameter return tube. This is piped to a new auxiliary return line that accepts low pressure flow and returns it to the paint mixing room. The new material required conversion of all existing facilities.

Inside Out

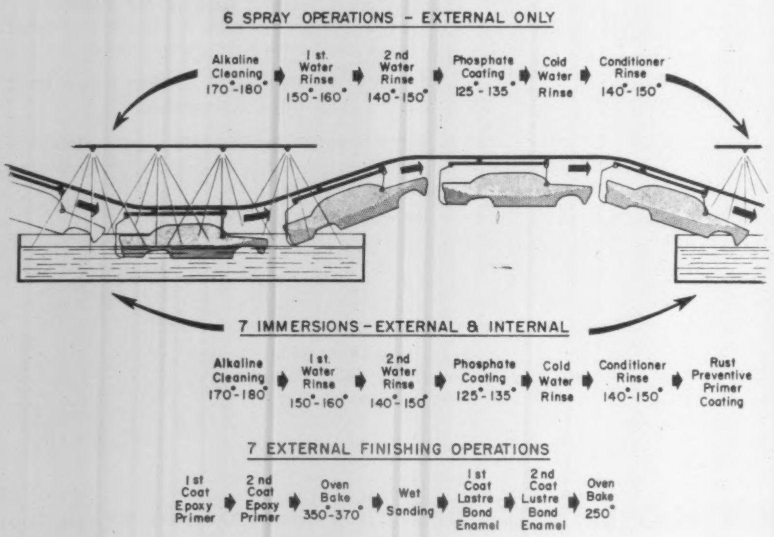
Improvements in finishing are not restricted to the outside of the car. Much of the customer annoyance eats its way out from the inside or underside of the body metal. Magic outside must be accompanied by sound insides.

The industry is continually upgrading the priming process. Three years ago Pontiac announced operation of new "flow coating" systems to insure the customer a flawless long lasting finish. This year Chrysler has revealed installation of $18 million worth of rustproofing equipment in its body plants. Plymouth, Dodge, Desoto, Chrysler, Valiant, and Dart passenger cars are subjected to a process that includes three metal cleaning baths, seven anti-corrosive dips, six spraying operations, and seven external finishing operations, requiring many automatically controlled temperature changes.

The rustproofing process begins when steel arrives in coils and sheets from the mills. It is given three spray baths of caustic metal cleaner to remove oil and dirt. Then a special drawing compound, created specifically for the Chrysler rustproofing system, is coated on the steel as it moves into the stamping operations. When the body of the car has been completed it moves along the assembly line to the anti-corrosion tunnel.

The Unibody includes heavier gauge box-section members designed to add strength and reduce rattles. Although the heavier metal would appear to deter the visible effects of corrosion, Chrysler has seen the need to offer the customer the results of what it considers to be the most intensive rustproofing process ever known to the automotive industry.

Such facilities with their extensive handling equipment and accurate control systems provide an improved product through the use of more automatic manufacturing operations.


6 SPRAY OPERATIONS - EXTERNAL ONLY
Alkaline Cleaning 170°-180°
1st. Water Rinse 150°-160°
2nd Water Rinse 140°-150°
Phosphate Coating 125°-135°
Cold Water Rinse
Conditioner Rinse 140°-150°
7 IMMERSIONS - EXTERNAL & INTERNAL
Alkaline Cleaning 170°-180°
1st. Water Rinse 150°-160°
2nd Water Rinse 140°-150°
Phosphate Coating 125°-135°
Cold Water Rinse
Conditioner Rinse 140°-150°
Rust Preventive Primer Coating
7 EXTERNAL FINISHING OPERATIONS
1st Coat Epoxy Primer
2nd Coat Epoxy Primer
Oven Bake 350°-370°
Wet Sanding
1st Coat Lastre Bond Enamel
2nd Coat Lustre Bond Enamel
Oven Bake 250°

Sketch and notes show stages of internal and external dip and spray coats which Chrysler Corp. cars receive in a new anti-corrosion finishing system installed for 1960 model production.

Why Settle for *Trichlorethylene* Alone?

DETREX Offers You PERM-A-CLOR, Plus Industry's Most Experienced Engineering Service

Solvent degreasing is a most economical method of metal cleaning. And DETREX PERM-A-CLOR is a premium grade trichlorethylene product—outstanding in stability, cleaning ability and solvent mileage. But PERM-A-CLOR is only part of the DETREX story.

Add DETREX's engineering organization—the most thoroughly trained men in this field—and you have another important reason why PERM-A-CLOR users get the most for their solvent dollar.

These experienced technicians stand ready to analyze your degreasing operation, and suggest procedures that in many instances reduce solvent consumption by a substantial amount. Put these experts to work for you today.

See us at the National Metal Exposition
November 2 to 6 · Booth 1219
International Amphitheater · Chicago

Depend on DETREX for Every Metal Cleaning and Processing Need

- PERM-A-CLOR NA (Trichlorethylene)
- Solvent Degreasers
- Ultrasonic Equipment
- Industrial Washers
- Phosphate Coating Compounds
- PAINTBOND Compounds
- Aluminum Treating Compounds
- Alkali and Emulsion Cleaners
- Rust Proofing Materials
- Extrusion and Drawing Compounds
- Spray Booth Compounds

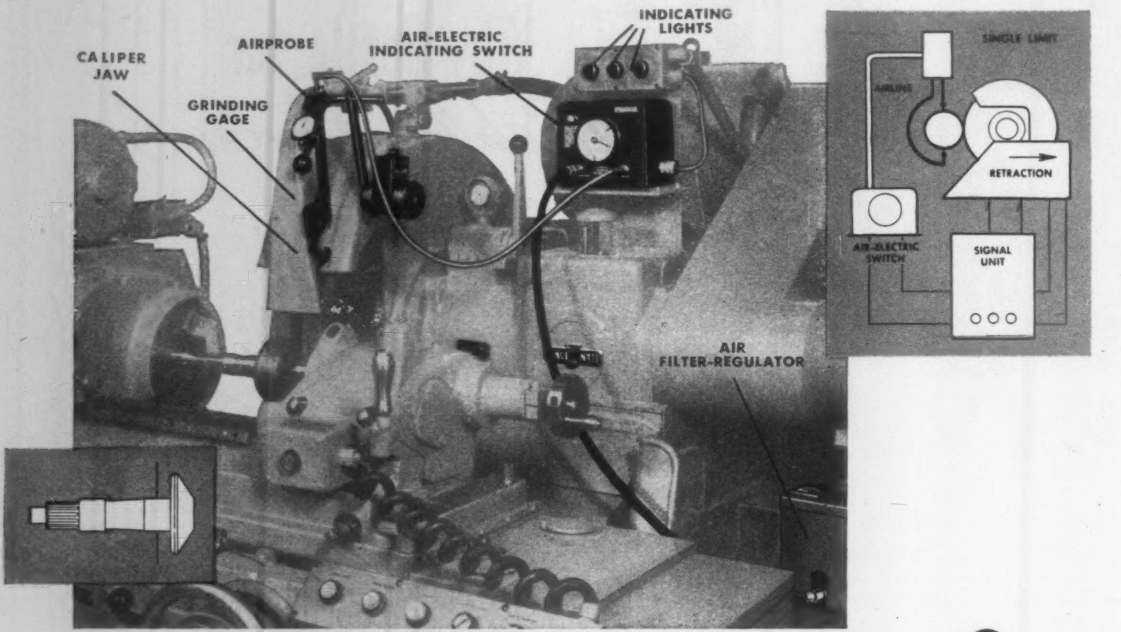
Dr. W. L. McCracken has written a most interesting paper—"The Truth About Solvent Degreasing". Send for your free copy.

DETREX CHEMICAL INDUSTRIES, INC.
Box 501, Dept. A-1159, Detroit 32, Michigan

World's Largest Exclusive Producer of Cleaning Chemicals and Equipment

CONTROL FINISH SIZE

Automatically! Economically!

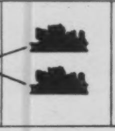


Automatic Control Gaging improves your grinding operation 3 ways . . .

1 It controls on the basis of finish size *only*, thus overcoming the disadvantages of timed cycle or fixed stop grinding. Wheel wear, O.D. variation in work to be ground, "give" in many of the machine elements, and flexing of the work, no longer affect accuracy and piece-to-piece uniformity of the finished part.

2 It controls *automatically*, thus you eliminate any errors caused by operator fatigue, inexperience, or inattention. The Federal automatic control gage never tires, will hold part size to .0001″ or better on a good machine, and is easily adjusted to control different sizes of work. Its air-electric system overlooks minor surface irregularities which confuse size readings of other gages.

3 Automatic control gaging makes it possible for one operator to handle two grinders performing the same or different operations. Here's an actual case history of direct labor cost savings:

	MEN	MACHINES	COST PER PIECE	PRODUCTION RATE pieces per 8 hr. shift
BEFORE			$.03585	1344
CONTROL GAGING INSTALLED				
AFTER			$.01526	1386

SAVINGS (per piece)	$.02059
RATE INCREASE (per shift)	42
TOTAL SAVINGS (per shift)	$28.59

EQUIPMENT COST AMORTIZED — 60 DAYS

HOW IT WORKS

The Federal automatic control gage measures the work continuously *as metal is being removed* and automatically retracts the wheel the instant finish size is reached.

EASY TO INSTALL

This standardized Automatic Control Gage (Model 133M-103 illustrated) is stocked for speedy delivery. Only a few components to install. Easily applied to any plain grinder having hydraulic wheel slide. Can also be used in connection with wheel slide stop to *additionally* provide spark out.

Federal control gages are also available through machine tool manufacturers for control of either plain or I.D. grinders and are supplied as part of the grinder package. When discussing machine tool requirements, be sure to specify FEDERAL gaging. Federal maintains close engineering alliance with leading machine tool manufacturers. They, too, will be glad to discuss automatic control gaging with you.

For more information, contact the nearest FEDERAL representative or write . . .

FEDERAL PRODUCTS CORPORATION
93911 Eddy Street, Providence 1, R. I.

Ask **FEDERAL** *First*

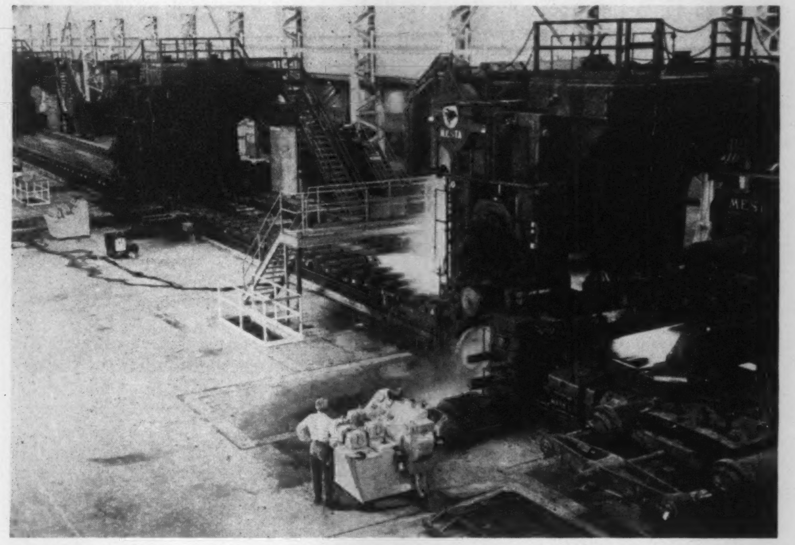
for recommendations in modern gages . . .

Dial Indicating, Air, Electric, or Electronic – for Inspecting, Measuring, Sorting, or Automation Gaging

Circle 685 on Page 19

western trends

BY PATT PATTERSON
Los Angeles, Calif.



Hot strip mill at Kaiser Steel's Fontana plant can handle slabs up to 72 inches wide. After leaving a furnace, typical slab is processed through the 11 rolling units to the coiler in approximately 2 minutes. At such processing speeds, automatic controls are a necessity. The new mill is part of a plant with a yearly capacity of 2,933,000 ingot tons.

No Other Way

THE NATION is not generally inclined to look at the West as a producer of basic metals—except for silver and gold. Yet an increasing amount of production is being charted for the Western states. In the Pacific Northwest both aluminum and copper ores are being mined and converted to basic metals.

Because of the growth of the Western area as a metal market, new mills are being built, and existing facilities enlarged to take care of the increased demand for metals. Most of the major steel companies have Western plants, and there is a growing local industry appearing.

It is interesting to note that in the production of basic metals a large degree of automation has been in use for years. Because of the very nature of some of the massive operations necessary to form molten or ingot steel into finished forms, manual handling and control could not be utilized, and automatic equipment was developed to handle jobs that man could not.

A good example of this "necessary" automation is the 86-inch, hot strip mill at Kaiser Steel's Fontana plant. The unit is actually a system, with three new furnaces to preheat slabs prior to rolling, a scale breaker, a 136-inch broadside mill to widen slabs, and four 89-inch mills to lengthen slabs—all new equipment which has been integrated with an existing six-stand, 86-inch finishing mill.

The hot strip mill is designed to convert 6-ton steel slabs which measure 22 feet long by 40 inches wide by 4 inches thick. From the original size, the slabs are converted into a coiled tin mill hot band only 1/16 inch thick, and more than a quarter of a mile long. The whole process takes only two minutes, which would not allow for manual operation of each phase, even if the equipment was designed for this type of control.

Many Examples

The State Tube Corp. of Los Angeles is installing additional automatic equipment in a plant which automatically produces resistance welded steel tubing from strip steel. The new equipment will include materials handling installations.

A good deal of Western brass requirements is turned out in Paramount, Calif., by a mill of the American Brass Co. ABC is only one of a number of major producers of metal products which have set up large scale operations in the West. The output of the Paramount mill is estimated at 30,000,000 pounds per year of tube, sheet, strip, rod, and other drawn and formed shapes in copper, brass, and bronze.

The mill contains a foundry which produces billets for an extrusion line featuring a huge Loewy extrusion press. After the billets are poured from a furnace, they are sawed to length and then heated in an automatic chain conveyor, gas-fired furnace before going to the extrusion press.

The sheet and strip line have highly automated rolling mills, a continuous cleaning and pickling machine, and gas-fired process annealing furnaces. One of the gas-fired annealing furnaces can handle up to 10,000 pounds per hour of copper tubing feeding through on roller conveyors.

Another Eastern manufacturer opening a brass mill in the West is Titan Metal Manufacturing Co. of Pennsylvania. The firm's new, highly automatic mill in Newark, Calif., is one of the San Francisco Bay area's first. In addition to rod and extruded shapes, the new plant turns out forgings in brass.

General Electric Announces Newest In The Complete Line Of Adjustable-Speed Drives

PARMATIC SPEED VARIATOR...newest in General Electric's complete line of packaged adjustable-speed drives . . . provides greater machine flexibility, better quality control, higher output and efficiency.

STATIC POWER

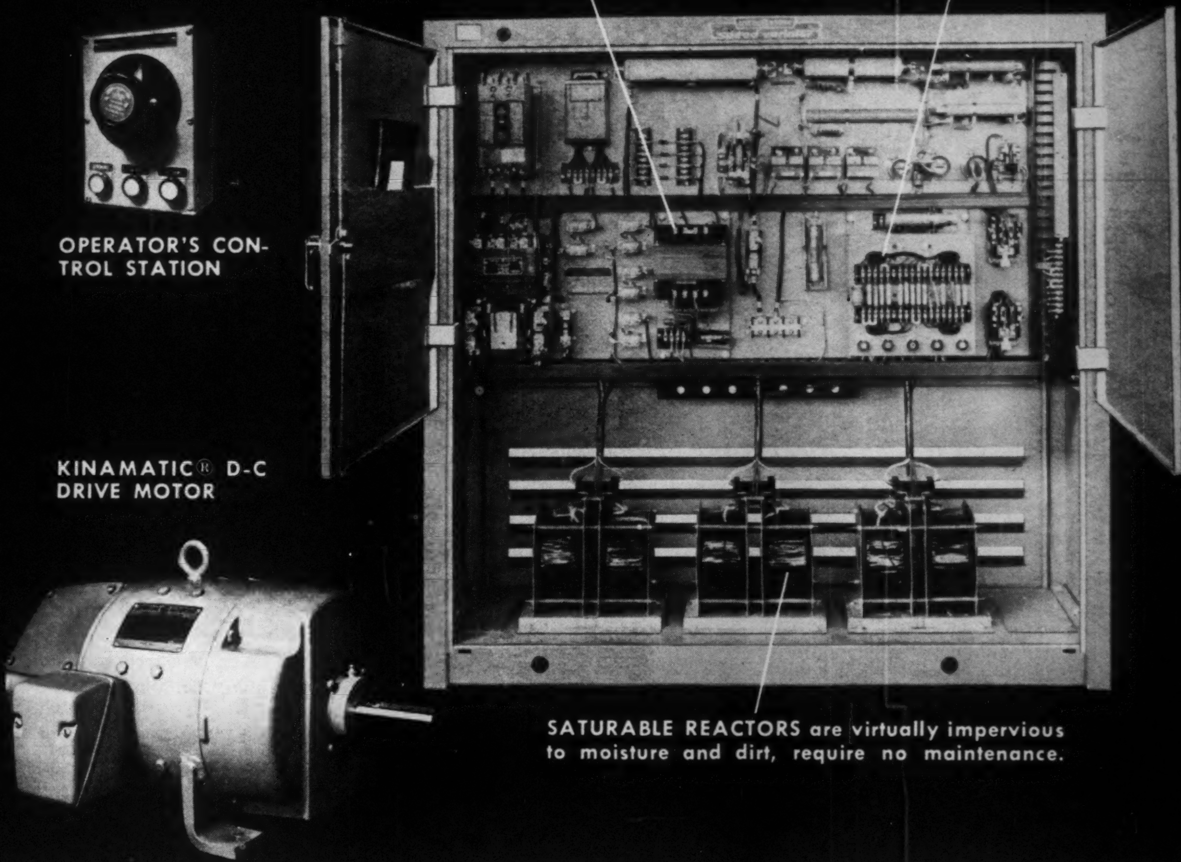
for less maintenance, less downtime, added profit. New excitation and power conversion systems have no rotating parts. Sealed silicon rectifiers and saturable reactors need no warm-up, virtually eliminate power unit maintenance.

25% SMALLER

for easier installation. Reliable, long-life G-E components are factory assembled in compact, space-saving power unit, wired and tested before installation to assure accurate control, reduced installation time and expense.

50% LIGHTER

for lower shipping and handling costs. New Speed Variator meets industry's demand for lighter, more powerful drives—packs more power, weighs 50% less than other drives of comparable rating, 2000 lbs less in 100-hp ratings.



STATIC EXCITER with silicon rectifiers for motor field excitation and control power.

AMPLISTAT REGULATOR with adjustable acceleration and deceleration.

OPERATOR'S CONTROL STATION

KINAMATIC® D-C DRIVE MOTOR

SATURABLE REACTORS are virtually impervious to moisture and dirt, require no maintenance.

FIELD PROVEN

by two years' impressive on-the-job performance in several hundred installations in 15 industries. Experience indicates high operating efficiency, lower cost installation and maintenance for a greater return on your investment.

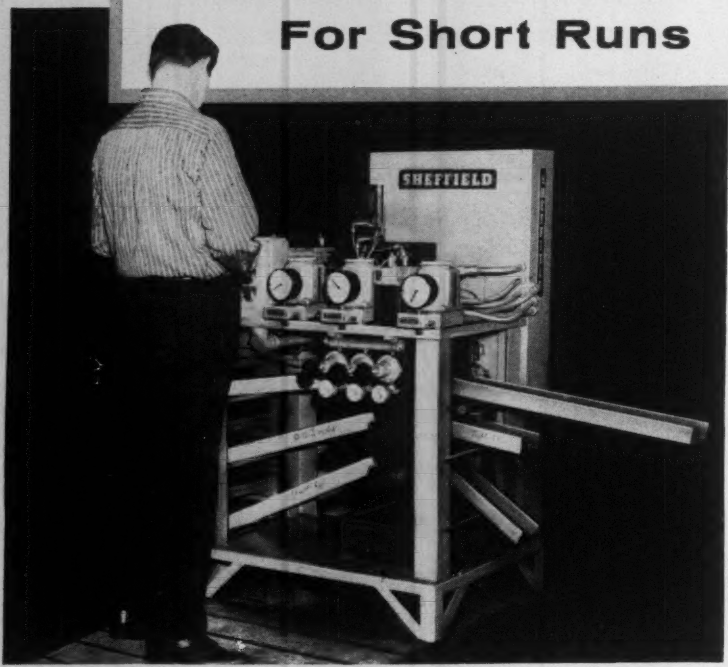
- **GOOD SPEED REGULATION:** 5% with 100% load variation. Closer regulation available with modification.
- **WIDE SPEED RANGE:** Standard Parmatic Speed Variator provides 8 to 1 range or wider if required.
- **RESISTS CONTAMINATION:** Saturable reactors and hermetically sealed rectifiers resist dirt and moisture.
- **QUIET AND VIBRATIONLESS:** New power unit design eliminates noise and vibration—expands drive versatility.

Limitations: G-E Kinamatic Speed Variator with motor-generator set is recommended for applications requiring power absorption for stopping or overhauling loads. *For more information,* call your General Electric Sales Engineer, or write for GEA-7012, Section 821-1, General Electric Company, Direct Current Motor and Generator Department, 3001 East Lake Road, Erie, Pennsylvania.

GENERAL ELECTRIC

Circle 686 on Page 19

Automatic Gaging
Now Profitable
For Short Runs



If you have short run jobs requiring close tolerance control, Automatic Gaging can now provide important economies available heretofore only in mass production operations.

Typical is an automatic gage now in use by a bearing manufacturer. This machine with quick-change tooling inspects and classifies 12 different types of parts in an 8 hour shift. Bushing type parts from the bar machines are automatically segregated into 7 size classifications involving OD, ID and width. The savings are significant.

It protects product quality by 100% inspection
•
It reduces inspection time to a minimum
•
It eliminates the costly errors of manual inspection
•
It has become economically sound due to the recent developments which have given the automatic gaging machine a high degree of flexibility.

Investigate automatic gaging for your operations. Write the Sheffield Corporation, Dayton 1, Ohio, U.S.A., Dept. 3.

the SHEFFIELD corporation
of Bendix Aviation
manufacture and measurement for mankind

8407

Circle 687 on Page 19

The furnaces at the mill are automatically charged with raw materials by a vibratory feeder setup. Heart of the operation is the extrusion mill which can turn out diameters up to 3 inches. Billets from the furnace are extruded through four sets of dies to make round, hexagonal, square, and special shapes.

The billets do not pass through a regular furnace before going to the extrusion mill. After leaving the cutoff saw, they automatically pass through induction heating equipment where the 1420 F extrusion temperature is reached in only 90 seconds.

Tin Plate

With food processing one of the major industries on the West Coast, can maufacturing lines have long been a reality, but makers usually had to look eastward for their supply of tin plate. In the past few years, however, Western mills have been producing tin plate.

At Pittsburg, Calif., Columbia-Geneva Steel Div. of the giant U. S. Steel Corp. recently built a tin plate line for producing electrolytic tinned steel strips for canners.

The new line, which is the third electrolytic tinning line at the Pittsburg plant, has automatic controls that regulate and synchronize the majority of the mill's functions. Pinhole detectors, radiation gages for measurement of both base steel and the coating thicknesses, flow line indication equipment, surface inspection instruments, and classifying devices are all part of the closed loop system.

One of the West's first continuous annealers is in operation at the Kaiser Fontana plant. Another one will soon be in operation at the Pittsburg, Calif., plant of U. S. Steel. In annealing, the steel strip is heated to temperatures up to 1350 F after cold reduction has taken place. Automation is a necessity in a continuous annealer. In operation the lead end of a coil of steel is electrically welded to the tail of the preceding coil to form one continuous ribbon that can travel through the line at speeds which often reach 1500 feet per minute. At these speeds, correction of temperature must be instantaneous, and controlling must be automatic.

Circle 688 on Page 19→

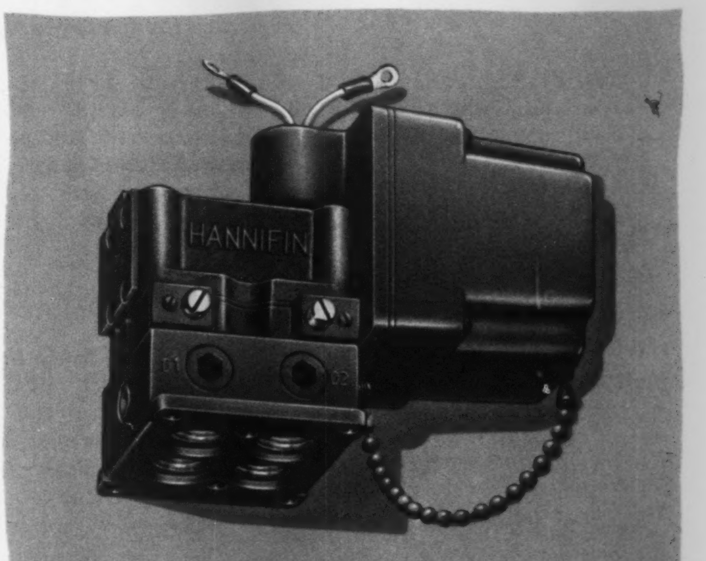
PARKER-HANNIFIN FLUID-SYSTEM COMPONENTS

From **HANNIFIN**...

unit construction

to give you air valves

that do more jobs



Hannifin ⅜" four-way valve with "universal" base and new Speed Control section. Single-solenoid actuated, 10 other actuators available.

Hannifin's exclusive "spool-poppet" seals bubble-tight at either end of its short stroke.

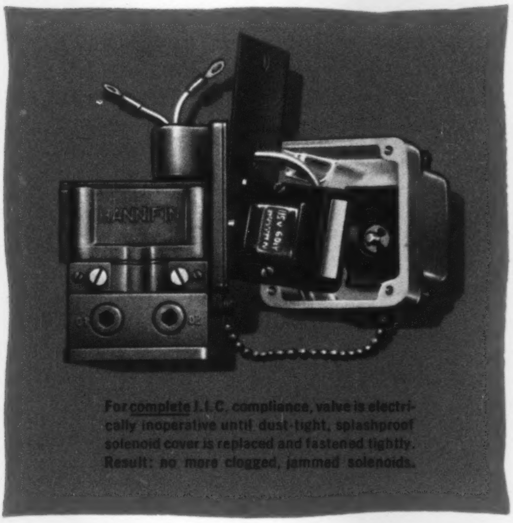
One of the versatile—and most popular—Hannifin air control valves is this "CC" series, single-solenoid model. It is available for either ¼" or ⅜" air lines and is gasket-mounted to its own base. This particular base (one of three choices offered) can either be O-ring gasketed to your manifold or mounted over an opening in your bracket or machine. It will receive all four lines from below or take the inlet line from below and the two cylinder lines out one side. Or, you can make all connections at the sides.

When it comes to actuation, Hannifin offers an even wider selection: hand, foot, cam, pressure, single or double solenoid.

When necessary, you can remove this entire valve from its base without disconnecting air lines. Or, the exclusive "spool-poppet" can be replaced without even breaking electrical connections.

The "CC" series, like all Hannifin valves, is designed with "full flow" internal passages as large or larger than its rated pipe size.

You will find these and most other Hannifin valves described in Hannifin's new "Valve Finder." Get your copy from your Hannifin man, listed in the A-Z volume of Thomas' Register, or write:



For complete J.I.C. compliance, valve is electrically inoperative until dust-tight, splashproof solenoid cover is replaced and fastened tightly. Result: no more clogged, jammed solenoids.

HANNIFIN COMPANY
525 South Wolf Road • Des Plaines, Illinois

A DIVISION OF PARKER-HANNIFIN CORPORATION

With a Fuller Airveyor Conveying System . . .

Unloading 30 Tons of Feed Ingredients In Less Than One Hour Is a One Man Job at Ralston Purina

Operator controls unloading of feed ingredients at rate of 30 tons an hour — up 12 stories to storage, just by pushing a button.

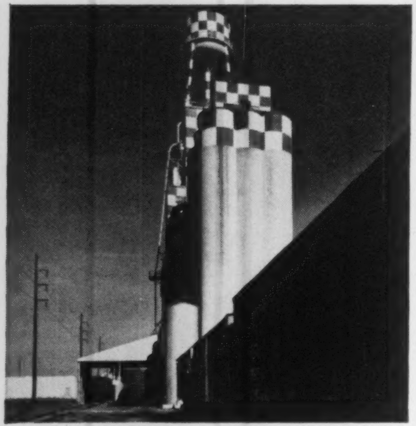
A Fuller Telescopic Airveyor® pneumatic conveying system moves bulk animal and poultry feed ingredients from siding to storage at Ralston Purina's Harrisburg, Pa., mill. The operator keeps the Airveyor nozzle buried in the material by regulating the length of the hose—the telescopic Airveyor conveying system does the rest.

Soybean meal, midds, bran, and other ingredients are sucked vertically 165 feet up 12 stories to any one of 30 storage bins. As the operator works deeper into the car, he simply pushes a button to raise or lower the hose one foot or twenty to reach *any* point within the car. Work never stops to add or take off sections of hose.

Obtaining the savings inherent in bulk purchasing, eliminating the dust hazard, and greatly reducing handling costs are some of the ways Fuller Airveyor conveying systems cut operating expenses in the moving of dry, bulk materials.

Consider the low initial cost and many operating economies of Fuller pneumatic conveying systems when you plan to increase plant capacity. Write or phone today outlining your problem. Fuller will gladly furnish additional information with appropriate recommendation.

1323C
A282



FULLER COMPANY GENERAL AMERICAN TRADE MARK

FULLER COMPANY
162 Bridge St., Catasauqua, Pa.
Subsidiary of General American Transportation Corporation
Offices in Principal Cities Throughout the World

Fuller
. . . . pioneers in harnessing AIR

AUTOMATION

NOVEMBER 1959

A Matter of Class

It has been adequately shown by considerable experience that to apply the principles of automation successfully, the best road is one of manufacturing engineering on a broad systems basis. This approach comprises the evolution of the processing system from the standpoints of the process, the handling, and the controls.

Automation technology is of greatest value profitwise when implementation follows a well-developed manufacturing system analysis. In most cases such planning can mean the difference between success and failure in advantageous adoption of this modern manufacturing technique.

All too often we hear the complaint of poor return on the investment only to find the manufacturer has shortchanged his operation to save a few dollars. A control system has been purchased, or the lowest of a group of bidders has been selected to produce a piece of equipment, without having first engineered in detail the entire system requirements and specifications.

In the words of some of the builders of automation devices and equipment, "We found ourselves bidding on an entirely different class of equipment."

There is no substitute for the necessary engineering and good communications in management's trip down the automation road. In the lead article in this issue, top executive thinking and experience in regard to the engineering involved in acquiring new automated equipment is detailed along with some basic rules for success in handling a complex problem of this nature.

Recognition of this matter of "class" is critical if a suitable rate of return on investment is expected. Careful attention to detail specifications will reveal few cases of precisely identical equipment or systems. Study will show which is best for the job at hand.

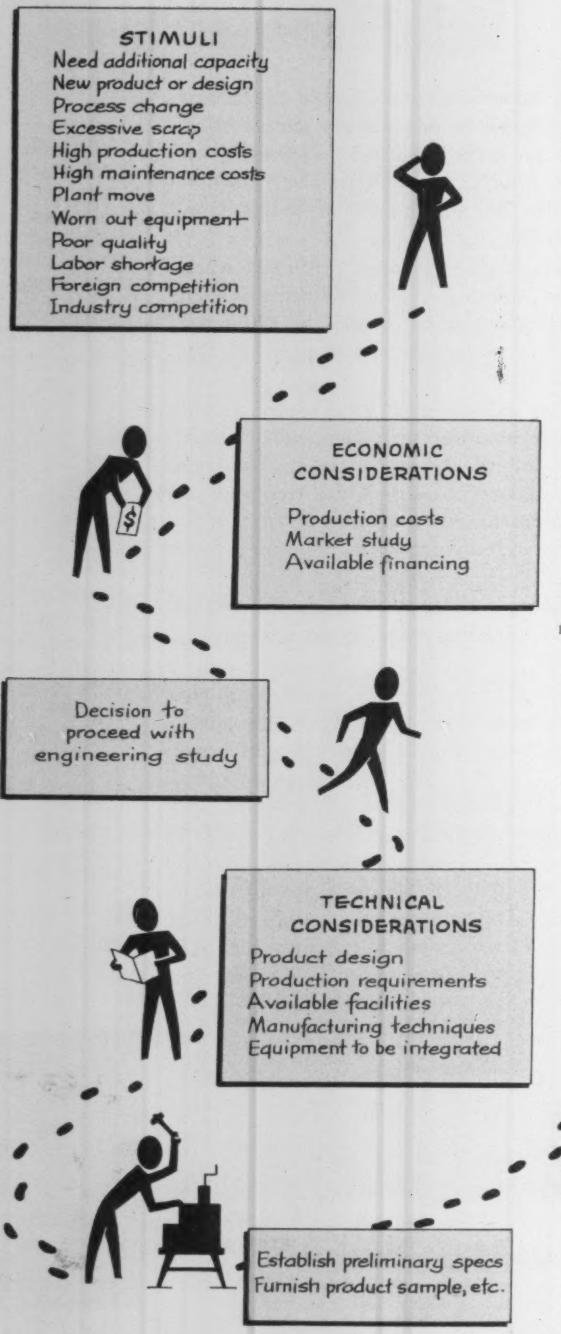
EDITOR

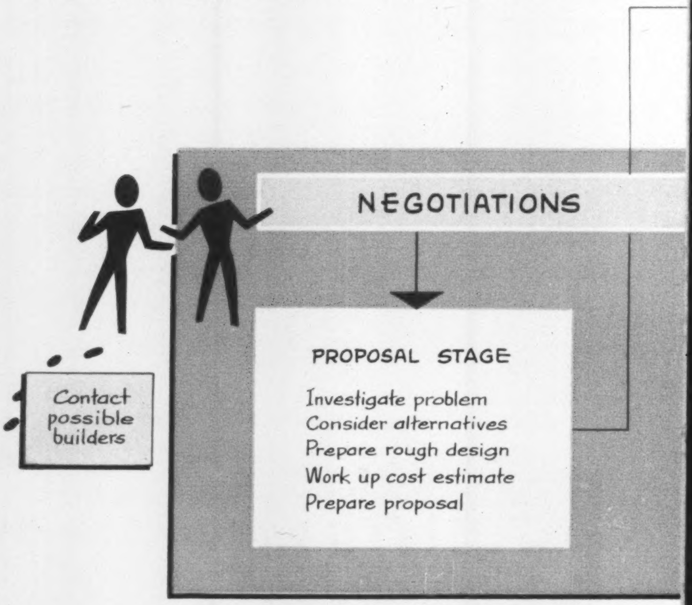
ENGINEERING AUTOMATED EQUIPMENT—WHO PAYS?

By **ROGER W. BOLZ**, Editor

THE DEVELOPMENT of good, reliable automated equipment is fraught with many problems, but once achieved, can produce some outstanding profit results. Some equipment builders raise poignant questions concerning buyers of equipment who ask for free engineering or free servicing to an extent that is unreasonable. Others raise the point of demand for perfection or no pay even though their specifications may be vague or incomplete. Is there a really ethical and businesslike manner for handling new special equipment acquisitions that could be standardized as being fair to both parties involved in such a project?

Honest appraisal of this critical problem reveals many facets. No clean-cut, simple answer is possible. Discussion of the problem with many top officials


STIMULI
Need additional capacity
New product or design
Process change
Excessive scrap
High production costs
High maintenance costs
Plant move
Worn out equipment
Poor quality
Labor shortage
Foreign competition
Industry competition
ECONOMIC CONSIDERATIONS
Production costs
Market study
Available financing
$
Decision to proceed with engineering study
TECHNICAL CONSIDERATIONS
Product design
Production requirements
Available facilities
Manufacturing techniques
Equipment to be integrated
Establish preliminary specs
Furnish product sample, etc.


Contact possible builders
NEGOTIATIONS
PROPOSAL STAGE
Investigate problem
Consider alternatives
Prepare rough design
Work up cost estimate
Prepare proposal

Whether designed in-plant or outside, engineering costs for automatic production equipment are high. Recognizing the fact that such costs are basically assessable as manufacturing research expense, this article examines the buyer and builder aspects and reflects the thinking of many of today's top executives in reaching a unified and ethical solution to the knotty problem of, "Who pays?"

in industry clearly reveals that rules alone would not provide an answer. It could be said that if fairness, equity, and honesty were exercised by both buyer and builder there would be no problem. However, this would be oversimplification inasmuch as full understanding of all areas of the problem is implicit in this assumption and by and large this is very often just not to be expected.

Because "who pays for the engineering" is an important question with automated equipment, an attempt at clarifying the problem is in order. Automation has ushered in an utterly different kind of situation with new equipment.

Many buyers have yet to recognize the radically different approach needed for successful handling of new automated system acquisitions. The difference arises largely in the change from standards to specials, the key factor being that builders of special automated equipment cannot expect orders for further identical machines over which engineering costs can be amortized. Needless to say, in every case the buyers of equipment will have to absorb these costs, in the final analysis, if the builders are to stay in business.

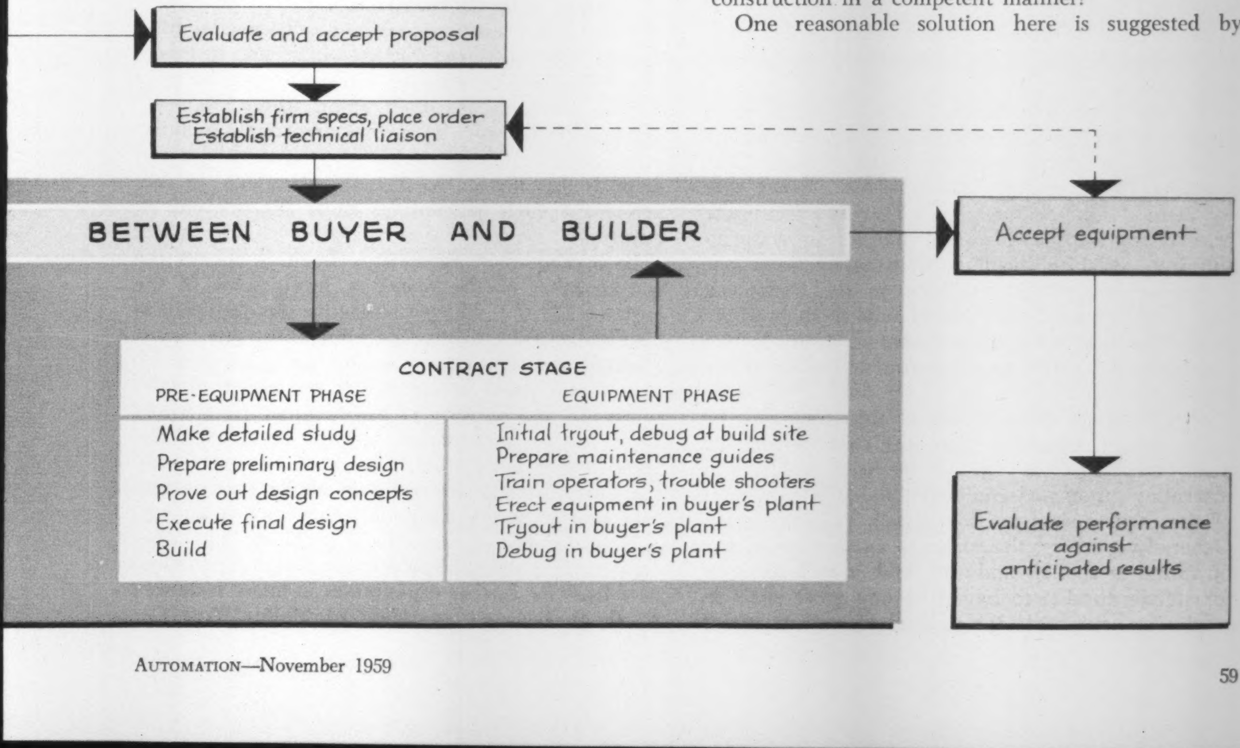
In reviewing the many aspects of the problem, some key points that complicate the solution stand out.

Gamble in Prices

Machinery builders for many years have made a practice of quoting firm cost figures on machinery. Today, builders experienced in the field of equipment manufacture recognize that it is virtually impossible to predict accurately the cost of building a piece of really new equipment. The more complex the machinery, the greater is the gamble in firm prices.

Only with rather completely detailed engineering can building cost estimates be fairly accurate, but here the basic problem is again the engineering costs. The builder must ask himself, "Is it wise to gamble on getting an order?" The buyer, however, must consider, "Has the highest bidder done the most careful engineering, is the lowest taking a long shot?" Can the buyer take a chance on buying special production equipment by such an approach? Is it wiser to look for an eminently successful builder and then, like the selection of a qualified architect, have him create the needed design for acceptance prior to construction in a competent manner?

One reasonable solution here is suggested by


Evaluate and accept proposal
Establish firm specs, place order
Establish technical liaison
BETWEEN BUYER AND BUILDER
Accept equipment
CONTRACT STAGE
PRE-EQUIPMENT PHASE
EQUIPMENT PHASE
Make detailed study
Prepare preliminary design
Prove out design concepts
Execute final design
Build
Initial tryout, debug at build site
Prepare maintenance guides
Train operators, trouble shooters
Erect equipment in buyer's plant
Tryout in buyer's plant
Debug in buyer's plant
Evaluate performance against anticipated results

J. Daugherty, vice president-engineering, Giddings & Lewis Machine Tool Co. who comments: "We have for many years thought that a machine tool builder should receive an engineering order from a customer to make up a proposal which requires a considerable amount of study and preparation. This is fairly common in other industries, as architects and civil engineers usually receive a fee for the preparation of a proposal. It is common in government circles . . . to pay the expense of proposals . . . and I suppose the reason that machine tool builders seldom get this sort of consideration is just because they do not get together and make a firm stand . . ."

C. F. Barnes, president of Associated Spring Corp., makes a rather pointed separation along these same lines when he states: "In most of the areas where we have been faced with the acquisition of capital equipment, the payment of engineering costs or services has been dependent upon the type of equipment involved. Where engineering and development is a major part of a new piece of special equipment, we have felt the obligation of payment for this service. However, if the equipment is more or less of standard make and only necessitates the correlation of this equipment for a quotation, we have felt that this service should be rendered free of charge."

Engineering the Key

The resultant of the long practice of quoting fixed prices in the special machinery field has been to implant the idea that engineering costs are insignificant and can be ignored. While this may be virtually true on standard devices and machinery, the opposite is true on special automated equipment and controls.

The move into automation involves a considerable increase in engineering costs, creating a new situation of unfamiliar proportions for many buyers. One machine tool company vice president makes this comment: "If we charge what we feel is a legitimate price taking into consideration that we are going to run into certain difficulties, then many times our prices are out of line, at least in the customer's eyes. If we quote a price which suits them, we normally then take a beating." However, failure to recognize there is no "cheap" way out has raised many difficulties.

Significant in this regard is this comment by J. M. Moon, executive vice president of Signode Steel Strapping Co.: "One of the basic problems in marketing automated equipment today is that most of the requirements are for custom-built machines. Generally speaking, the complete automation of any operation is special, and the field is still too new for standardization to have had any great effect in producing equipment at the level of costs to which purchasers have been accustomed.

"The customer usually contends that the builder will find a ready market for the sale of additional machines, and that he should be credited for his part in pioneering a new development. The challenging aspect of the project, as well as the theoretically possible, although perhaps improbable, potentials are exciting enough in too many instances to overcome sound business judgment. These factors are often apt to lead the builder into unprofitable situations."

Here the key assumption of subsequent sale to others must be evaluated. All too often this is not much of a factor. Another vice president underlines this fact with this pointed comment: "We find that there is not much of a profit in simply exchanging dollars. Many of the projects that we tackle are single shot deals and rarely are repeated so what we learn is normally of no value on the next job up."

Since every equipment builder has a direct responsibility to remain strong, competent, and profitable it becomes obvious that the amount of "free engineering" practical to land desirable orders must be limited. R. F. Onsrud, president of Onsrud Machine Works Inc., indicates the normally expected limits: "Quoting on special or automated machinery usually does involve a certain amount of 'free engineering' on the part of the builder; at least enough so that the customer can visualize how the job is to be done and the builder has some basis for a quotation. Customer demands for engineering beyond this are an imposition and should be paid for. Were the customer to employ the services of a consulting engineer, even for preliminary information, an expert normally charges from $75 to $125 per diem."

Agreements on Patents

Although there is ample proof that a great percentage of the automation jobs produced offer little in the way of repeat orders, there are instances where this can be a factor. Parallel or similar production problems are often found where engineering investments can be further amortized. In other cases, patent situations arise where the builder can diversify his market to distinct advantage. In any agreement such possibilities must be resolved in advance.

In making such agreements there is always the consideration of the moral or legal rights of the customer. Fred L. Hooper, executive vice president of Cambridge Wire Cloth Co., emphasizes this factor: "Should the customer pay for these services; all new ideas would automatically be, either morally or legally, the property of the customer. This would deter further exploitation of good ideas that may have further application." Again on an engineering basis the customer can and does ask for a satisfactory lead time to insure adequate competitive advantage.

However, one of the ethical problems that arises contests the validity of proprietary design innovations as a basis for further exploitation in many instances. C. R. Rosborough, president of Moline Tool Co., raises this point: "We are expected under our present system to submit quite elaborate drawings and specifications with prices to the prospective customer, and they have the privilege of even submitting our designs to our competitors, giving them the benefit of these designs and specifications, and asking our competitors to bid." Certainly there is an answer to this problem. It is provided by this straightforward comment by the executive vice president of a large steel company: "In any business transaction a degree of fairness, equity, and honesty must be exercised by both buyer and seller. Certainly if there is to be a continuing relationship, this is essential."

▶ Understanding Performance

Basic to the problem of satisfactory procurement relationships with new installations is the demand for specific performance guarantees. Many of the difficulties encountered hinge on poor communications. Often there is a lack of clear understanding on both sides as to just what is guaranteed.

It is of course realistic for the buyer to expect that the equipment builder will provide machinery, devices, and controls that will function as specified. But in this regard the specifications must be understood by both parties. There should, of course, be no question that such elemental items as bearings will operate at the specified rates of speed and under specified conditions without recourse to detail guarantees.

The unrealistic situation a builder may encounter is a demand for guarantees that equipment will perform at rated output in the buyer's plant without the builder's control over all local conditions that can affect production speed. Here, adjustments and compromises must be made.

R. M. Gordon, vice president of the Milford Rivet & Machine Co., makes this comment: "We are in the position of having customers come to us who have pretty well engineered their own machine requirements. On the other hand, there are customers who have not the vaguest idea of the type of automation which can be developed as an answer to their riveting problems.

"This often makes for very unreasonable demands, inasmuch as the customer who has engineered his own requirements feels there should be a guarantee that it would be made to his specifications and, therefore, will be workable. On the other hand, the customer who has done no work depends on us entirely and expects that we will guarantee it to be 100 per cent perfect based on our own 'know-how' and experience.

"We are inclined to believe that somewhere inbetween these extremes lies the real answer. Both supplier and customer usually have something to contribute which can only be fully developed by a thorough examination of each contributor's information. Oftentimes the contribution can take the form

CONSIDERATIONS FOR THE BUYER

ESTABLISH a desire on the part of your own people to want the machine program to succeed. This includes all production and maintenance personnel as well as the operator. The desire for success on the part of your people is more important than any other thing. A negative attitude can make the best machine builder give up. You can expect some mistakes and slow downs during the run-in period. If you have the type of operation that frequently requires new equipment, you will save money by hiring premium maintenance people.

- If possible, buy the machine from a builder with experience on the type of equipment to be purchased. He need not be big. The size of the builder is not indicative of his ability to build good machines. This is probably true of the machine builder more than any other type of business.

- Expect the builder to make a profit. A good machine builder, like yourself, cannot stay in business unless he does make a profit.

- Give the builder all the process information and machine specs he asks for. If you don't have them all, get them! And, they should be rechecked. A machine is no better than the information it is built around and, above all, don't forget the specs on the products the machine is to handle. You will find many products manufactured outside of the specs, particularly, in reference to size, without the knowledge of the manufacturer.

- Give the builder plenty of time to build the machine, if at all possible. So many times buyers sit on an order for six months and then want a $10,000 machine in days.

- Good machines are expensive, and custom machines are even more expensive. Don't expect any bargains. It's true that a given machine builder may have the most economical approach; however, this is a lot different than trying to get him to cut his price. If he starts to lose too much money, the machine builder may cut the debugging time, and it will cost you in the end. If it's a really difficult custom machine, you should expect that you may have to give him more money before the equipment is completed. In fact, many builders will only take such jobs on a time and material basis.

- Be reasonable and understanding. It will save you money because the builder will try harder.

- After the machine program has progressed through a reasonable period, if you find that the builder is incompetent or misrepresenting the facts, cancel and negotiate a settlement. Don't throw away good money after bad.

of a better defined problem on the part of the customer."

Another facet of the problem is outlined in this remark by a company president: "After the equipment has been built and installed, there must be a proving out period. During this period, both the buyer and the supplier must be prepared to use a great amount of patience and co-operation, for new equipment seldom performs without 'bugs' and the buyer's workmen seldom follow the supplier's instructions without deviations or mistakes. Quite often, there is interference, either from the union or due to the resistance of the buyer's employees. To protect the supplier, the purchase contract should have a clause specifying that the buyer's employees will give full co-operation in proving out the new equipment."

The general thinking on this performance problem is summed up by Carl E. Johnson, president of Acme Chain Corp., in this statement: "After the equipment is installed in our plant, we expect that it will give trouble-free operation with a minimum of maintenance cost. Unless we previously agree with a supplier of automatic equipment that it is being put in on an experimental basis, and that there is some conjecture as to its operation, we expect satisfactory service and trouble-free operation over a reasonable period of time."

Defining the Specs

A better defined specification on the part of the equipment buyer can eliminate a large portion of the difficulties involved in obtaining automated equipment. An overwhelming number of builder comments indicate that lack of appreciation for the amount of engineering involved in obtaining real dollar saving automation stems from failure to thoroughly understand the problem.

First, there is no possibility of knowing sure-fire solutions for all problems. Almost every production system, large or small, holds within it one or more knotty problems for which really good answers are just not readily available. An investment in engineering and research is necessary. Regardless of the process being developed, the equipment buyer should become involved to the extent of thoroughly understanding all facets and contribute heavily to the final solution. The payoff comes in financial success of the final system.

One president of a large automotive products company comments on this fact: "Many purchasers of automatic equipment do request a great deal of free engineering, but I feel that this is due mainly to inadequate staffing by the purchaser and is an imposition when there has been no preliminary work on their part."

Earl H. Bradley, president of B-I-F Industries Inc., indicates that full engineering understanding by the buyer is not only important in this regard but weighs heavily in the setting of reasonable performance data. He comments: "It seems rather obvious that a buyer of equipment must have sufficient information as to cost and performance to make an intelligent decision as to whether the equipment will function properly and prove an effective aid to his program. Obviously, some pre-engineering must be done to establish this point. In general it would seem that this is part of the job of selling by the supplier of equipment. Obviously at this stage only enough engineering should be done to permit a reasonable forecast of cost and performance. Equally obviously, somebody has to pay for this engineering. Since the manufacturer will not receive all the jobs on which he quotes, the engineering markup used must be high enough so that the jobs he does receive will pay for all the engineering he does for all customers. Where a substantial amount of pre-engineering is required, it may sometimes be appropriate to charge for this as a separate engineering project, with any subsequent equipment sale being a separate issue.

"The problem of vague and incomplete specifications is a difficult one, since adequate specifications require a more detailed analysis than customers are in general prepared to make. However, it is obviously impossible to guarantee performance unless there is a complete understanding of system requirements."

Finally, if the buyer does not become involved to the extent necessary, it becomes imperative he be ready to assume full engineering costs where specialized systems are being sought. Says B. E. Horst, production manager of Barber-Colman Co.: "If the request is for specialized engineering layouts and semi-detailed prints as to how the proposed project or process can be handled in a particular instance, we feel it only fair that the prospective purchaser issue an engineering purchase order to cover the creative thought as well as engineering labor to accomplish this investigation. Money so spent would apply against the actual purchase of equipment and would be an expression of good faith on the part of the prospective purchaser."

Manufacturing Research

In the final analysis, the major question to be resolved is basically one of whose burden is manufacturing research. Since practically all automation development falls into the area of manufacturing research, this question holds considerable weight today. Management must make the decision and set the policy.

Unquestionably those companies in the most advanced positions have well organized manufacturing research groups. Where company circumstance precludes a formal group of this nature it becomes imperative that such service be purchased as needed.

Manufacturing research has become a must. Any producer that depends entirely on proposals for obtaining process advancements or manufacturing research can hardly expect to be an industry leader.

The real value in new capital equipment comes in its return on the investment. Rational decisions can seldom be made without full detailed knowledge of the processing possibilities within the producers manufacturing group. J. M. Moon, executive vice president of Signode Steel Strapping Co., suggests that equipment price should more rightly be based on its profit return to the user, not on conventional pricing methods. "The builder must be completely objective in his appraisal of the opportunities given him to quote on special equipment. He should make an independent determination of the justification for the equipment in terms of savings to the purchasers. If it appears that the justification is questionable, he will be well advised to decline a bid. On the other hand, if the savings are adequate, then he should base his sales presentation on performance and net results rather than upon conventional prices or considerations of lesser significance."

CONSIDERATIONS FOR THE BUILDER

MAKE a profit. You can't give good service and build quality equipment if you aren't making money. You will seldom lose an order on price alone if the price is respectable. Make sure the customer understands all financial arrangements. Don't be bashful about money.

- Get in writing all the specs on the product, products, or materials to be handled by the machine. Give the customer as many machine specs as is practical, in writing. Also, get a representative supply of samples and check them against specs.
- Advise the customer, again in writing, what samples and test materials will be needed and who is to furnish what.
- Allow adequate cost for debugging the machine.
- If at all possible, get the customer to agree to come to your plant to accept and approve the machine. Changes are much easier to make in your own plant.
- Your contract should define individual responsibility for installation and how long the start-up call is to last. This should be fixed and not dependent on the machine performance.
- Define charges for service calls and make sure that the customer knows he's expected to pay for them. Have good, competent service men. It is difficult to break even on service calls, let alone make money. However, if a good job is done, service is a good sales tool for future business. If possible, always phone the man responsible for the machine at the customer's plant for the details before making a service trip. It will help you prepare for the trip and it, generally, saves about half of the service calls.
- Always put everything in writing.
- Don't quote on a job you can't do. Don't go too far afield unless you can finance a failure.

Here, the point is well taken but for a real meeting of the minds on the subject, the buyer must be in a position to realistically evaluate the capital situation in full.

Today's complex automated machinery and process systems have changed the rules of the game considerably. C. H. Thayer, vice president of Sun Oil Co., makes this clear in this statement on the subject: "In the process industries, there are two distinct types of automation. The first consists simply of hooking up standard devices such as centrifugal pumps, meters, control valves, and the like, for convenience and accuracy in operation, control, and accounting. Our experience indicates that this type of automation requires no special consideration in our relations with manufacturers and vendors. In most cases, standard equipment is involved and the usual vendor services and guarantees are in order.

"The second type is process automation (engineered systems) and in the present state of the art, any company which undertakes it seriously should be prepared to make large expenditures in personnel, training, and development. Even the simple continuous processes in an oil refinery have complexities far beyond the scope of conventional instrumentation. Even though certain conventional items may be included in the various control loops, it is our firm opinion that the application of instrumentation to process control when it involves several co-ordinated steps is primarily the function of the user and any abnormal service or guarantee requirements should be assumed by the user. There are, of course, cases in which the systems engineering is a matter of purchase contract for which the user pays on a time and material basis.

"As a further clarification of the special nature of process automation, we have found that it is often desirable to acquire devices from manufacturers on a trial basis inasmuch as the application is nonstandard. In this way, the manufacturer benefits from the application of his equipment without assuming excessive development costs. The larger benefits usually accrue to the user, assuming that the application is successful, and he is, therefore, compensated for his development costs."

In all probability, one of the most touchy points that must be faced in the question of engineering costs is bound up in the whole involved area of capitalization costs. It is recognized generally that there is some engineering cost included in every piece of equipment designed for production use. As the complexity grows the amount that is attributable to engineering grows to the point where it cannot be ignored.

All too often the buyer overlooks the fact that when his own engineers design production equipment, capital costs seldom include full engineering time and full overhead. Comparisons with such figures can make a vendor's prices look pretty far out of line. When *all* costs are included—recognizing debugging costs as a reality—the reverse is usually true.

Nevertheless, an important factor arises from study of in-plant design of new or unique productive equipment. In such instances management generally recognizes the engineering and development costs as manufacturing engineering research expense. The engineering and research costs on automated equipment fall into this category and should be so recognized regardless of who does the work. In this light and with this approach to capital equipment acquisition, the problem of engineering costs assumes its legitimate character and takes the whole question out of the foggy area. Such manufacturing research is rightly the province of the product manufacturer as a basic responsibility, not the equipment builder.

The rational solution to the problem is suggested by the vice president of research and development for one of the large petroleum concerns: "There are, of course, many instances in rapidly growing fields such as automation where an instrument manufacturer and user find it mutually beneficial to work jointly on a development program. In such cases the equipment manufacturer contributes technical manpower and instruments or other devices and the user contributes technical manpower and operating equipment for trial of the system under investigation. The equipment manufacturer hopes, of course, to come out with a new development that he may sell at a profit to other users. The co-operating user hopes to gain through achieving improvements and economies in his operations and through achieving at least a temporary advantage over his competitors in the field.

"It is perfectly obvious that an almost infinite variety of combinations and arrangements for an equitable distribution of costs for such projects are possible. Except in the very simplest of cases where the respective responsibilities are apparent or are established by long standing custom, it would appear desirable that the purchaser and the supplier reach some agreement as to the obligations of each party before the work is actually started. In more complicated situations where there is at least the possibility of a patentable invention arising out of the mutual activity, formal contracts covering the distribution of costs and sharing of the results, including patents, if any, are highly desirable."

Conclusions

There is little question that the most profitable equipment installed to date in any plant is the result of the combined talents of the buyer and the builder. The comments of the panel of executives quoted in this article gives ample proof of this. In the final analysis, economic justification for equipment is the prime factor of importance to both the builder and the user. The builder can supply technical knowledge and know-how in the form of equipment design and operation, the user in the form of manufacturing knowledge and process developments to achieve the desired end results.

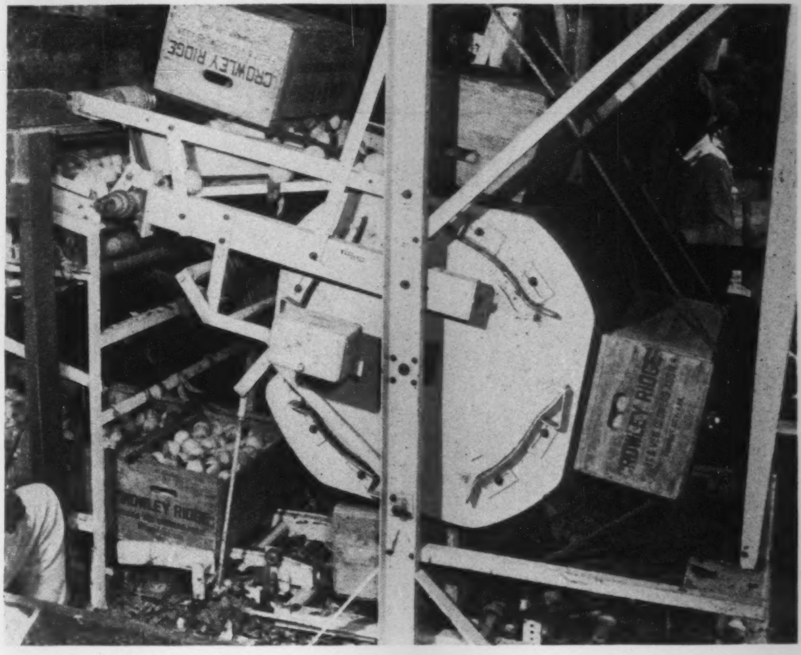
Many of the comments on this topic indicate that there is a strong feeling that procedures for the acquisition of custom automated equipment can be standardized, generally, as well as the ethics and practices. These do not present the main problem—that problem is communications. As an aid to solving the problem, Walter C. Larsen, manager of tape customer engineering, Minnesota Mining & Mfg. Co. suggests some good guidepost considerations for both buyer and builder which are outlined in two boxes on the accompanying pages.

Although no ironclad set of rules can solve the basic problem, it is obvious that better communications and understanding between purchasers and builders can raise the level of accomplishment in automation far beyond today's levels. Expression of opinion and interchange of ideas contribute to the advancement of this understanding.

are you stuck?

Since its inception AUTOMATION has helped increasingly in the solutions of hundreds of widely diversified practical problems in making manufacturing operations more automatic. Regardless of the character of the operation or system being developed, somewhere in industry a similar problem has been solved and, very often, equipment is available from reliable builders or suitable techniques are known to specialists.

Development can be simplified, engineering costs reduced, and reliability guaranteed with tried and proved equipment and devices available today for achieving successful automation. Whether the problem is simple or complex, practical or technical, if you have not as yet seen the answer to your need in the pages of AUTOMATION the Editors will be pleased to make special effort to help find the right answer. The vast reservoir of industrial know-how is yours for the asking. Take advantage of this reader service. Write to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio



1

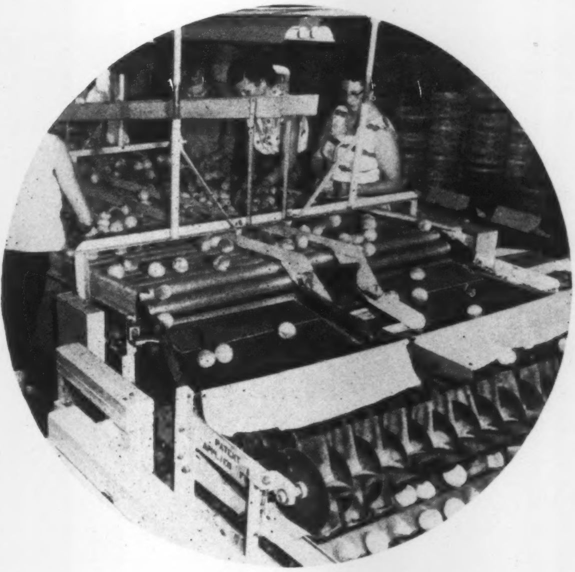
Mechanical dumper empties peaches out of field boxes used to bring them from the orchards. Loaded field boxes advance on conveyor at lower left. Trip, operated by cam surfaces on rotating drum, controls advance of individual boxes under the drum. Flexible belts wrapped around drum provide means to gently separate fruit from inverted boxes. Pair of moving roller chains holds boxes against drum while it rotates to invert the boxes.

AUTOMATION TODAY

PACKING PEACHES

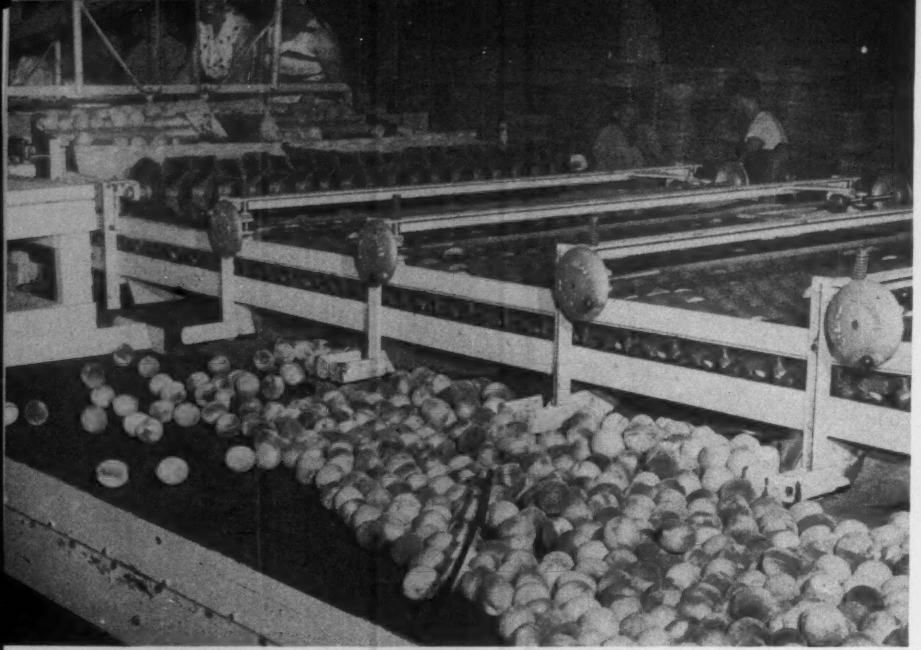
WHEN A PRODUCT comes in a variety of shapes and sizes, and is perishable and easily bruised besides, packing is a problem. Manual handling can adapt to variations in shape and size, but if the product is as tender as peaches, even cuts caused by fingernails can be a costly source of loss. In a peach packing plant (known in the trade as a packing shed) of the Summersweet Orchards Sales Co., operations have been automated to solve the packing problem. This packing shed can run 1000 bushels of peaches per hour, with less bruising of the product and lower costs than a completely manual operation.

Peaches come to the packing shed from the orchards in field boxes. The fruit is automatically



2

From the dumping machine the peaches are carried through defuzzing brushes and vacuum cleaning to a roller conveyor table for grading. The revolving rollers gently roll the peaches so that graders can inspect them. Graders stand along the grading table, pick out cull peaches, and discard them on the partitioned channel in the center of the roller conveyor. The good peaches need not be touched by the graders as they advance to the apron of the automatic sizer.



3

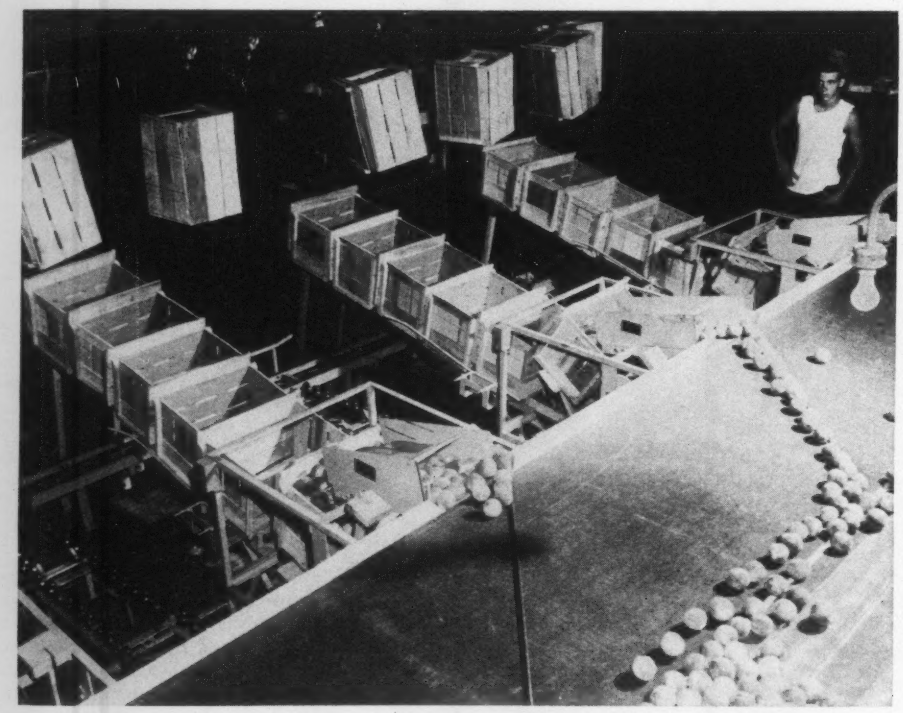
Sorting machine automatically sorts peaches by size. From the grading area (upper left) the peaches roll into the sizer, with each peach being guided into an individual pocket formed between adjacent sections of a conveying arrangement. As the conveying sections advance along the sorter, the spacing between them is gradually enlarged. Peaches drop out of their individual pockets when the spacing allows them to fall onto conveyor belts under the sorter. No. 1 size peaches are carried across to the main conveyor in the foreground. This belt conveyor takes them off (at lower right) to the crate fillers.

dumped from the boxes and "de-fuzzed." Graders manually pick out any culls as the peaches are moved on a conveyor belt to an automatic machine for sorting by size. From the sorting machine, choice No. 1 fruit is moved to a battery of four automatic crate-filling devices. Smaller fruit is discarded or manually packed in baskets as No. 2 peaches.

The crate-filling devices are supplied with empty wirebound boxes by gravity conveyor racks. One worker keeps the racks filled with crates that come to him by overhead conveyor from crate assemblers in another part of the plant.

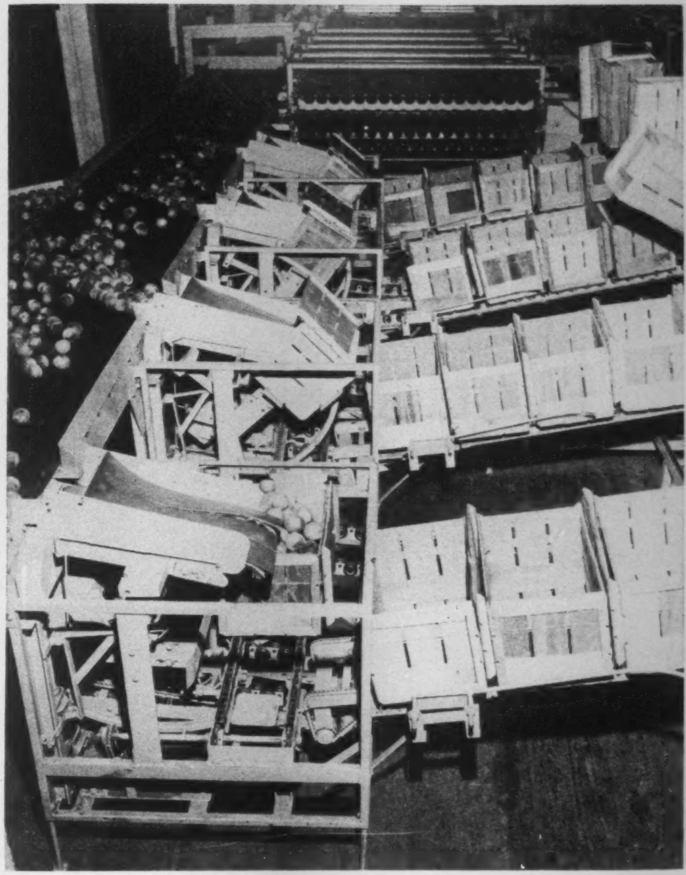
Empty crates are automatically fed into the filling stations, filled, and ejected. If required, peaches within four different size ranges can be separated on the sorting machine and simultaneously supplied to individual crate-fillers by using dividers lengthwise above the conveyor belt that carries the peaches to the fillers.

Filled crates go by conveyor to a hydrocooler.



4

Small metal rods serve as means to guide peaches on the wide conveyor belt into filling chutes without damage. Three of the four automatic crate filling stations are shown. Overhead conveyor in background brings empty wirebound boxes from crate assembly area. Attendant places them on gravity conveyors feeding the filling stations. Automatically filled crates are ejected to gravity conveyors that deposit them on the power conveyor running under the empty crate racks.

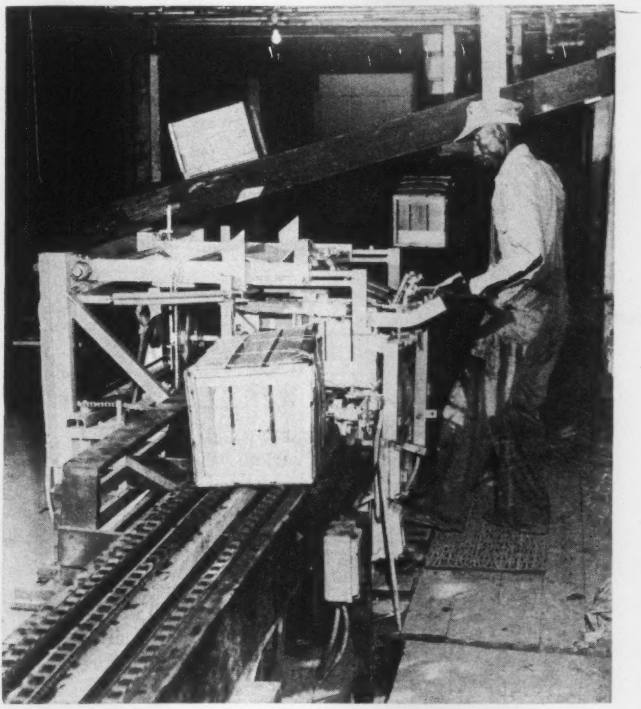


5

View of the four crate filling stations also shows sorting machine in background. Flow of peaches down filling chutes is controlled by heavy canvas covers that act as brakes. When an empty crate is taken from the supply rack and swung into filling position by counterweighted arms, it lifts the canvas on the chute and allows peaches to roll into the crate. As the crate is filled, gravity forces it down, and limit switches control ejection of the filled crate and placing of another empty one.

This is a tunnel-like chamber in which filled crates, their lids still open, are submerged and carried by a conveyor through chemically treated ice water. The crate of chilled fruit is moved to a wirebound box closing machine. That machine squares the crate, closes the lid, and bends the wire-loop fasteners to form a firm closure. The filled crate is then ejected onto a conveyor leading to the loading dock.

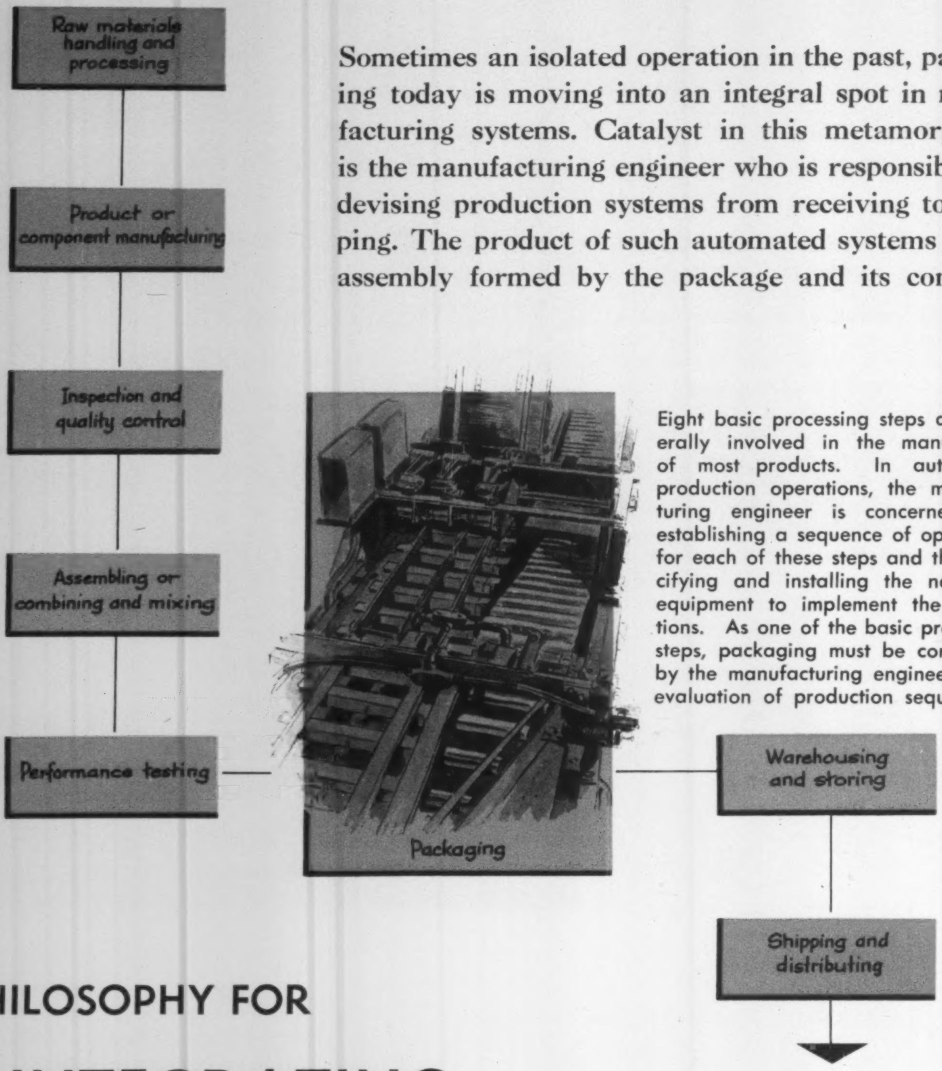
Operations in this peach packing shed are shown in the accompanying photographs. The mechanical equipment was installed by Trescott Co. Inc., except for the wirebound box closing machine, which was built by Stapling Machines Co.



6

Filled crates pass through a chilling bath and are conveyed to this wirebound box closing machine. Here the ends of the crate are squared, the lid is closed, and the wire-loop fasteners are engaged and closed. The finished package is then conveyed to the loading dock.

Sometimes an isolated operation in the past, packaging today is moving into an integral spot in manufacturing systems. Catalyst in this metamorphosis is the manufacturing engineer who is responsible for devising production systems from receiving to shipping. The product of such automated systems is the assembly formed by the package and its contents.


Raw materials handling and processing
Product or component manufacturing
Inspection and quality control
Assembling or combining and mixing
Performance testing
Packaging
Warehousing and storing
Shipping and distributing

Eight basic processing steps are generally involved in the manufacture of most products. In automating production operations, the manufacturing engineer is concerned with establishing a sequence of operations for each of these steps and then specifying and installing the necessary equipment to implement the operations. As one of the basic processing steps, packaging must be considered by the manufacturing engineer in his evaluation of production sequences.

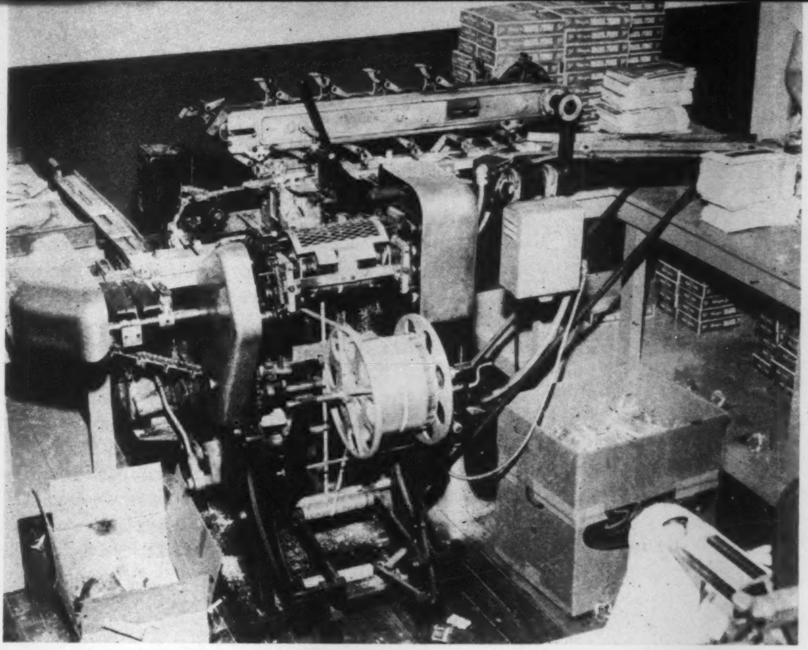
A PHILOSOPHY FOR

INTEGRATING PACKAGING PROCESSES

By **JULIAN E. WILBURN**, Associate Editor

INDUSTRIAL packaging can no longer be considered a separate operation which is performed in isolation from all other production operations. This turnabout in the traditional role of packaging products has been caused by the increasing application of automatic techniques to industrial processes. Automatic production systems are being designed to encompass all operations to be performed on the product from the receipt of the raw materials to the shipping of the completed product.

A few years ago, it was considered good practice to manually move the components of a product from machine to machine for various work performing operations. Quantities of completed components were transported to assembly areas where the parts were manually combined into the product. The assembled product was then moved to an inspection area, and, after inspection, the acceptable units were again moved to another area for packaging. Finally, the packaged product was transported to the shipping area for storage and additional handling before it was ultimately shipped to the user.



A common unit process used in packaging is wrapping. At Wayne Candies Inc. fudge bars are inspected as they are delivered from a cooling tunnel and are fed into this wrapping machine where card insertion, wrapping, and sealing are done automatically. The candy bars are conveyed from the machine for boxing.

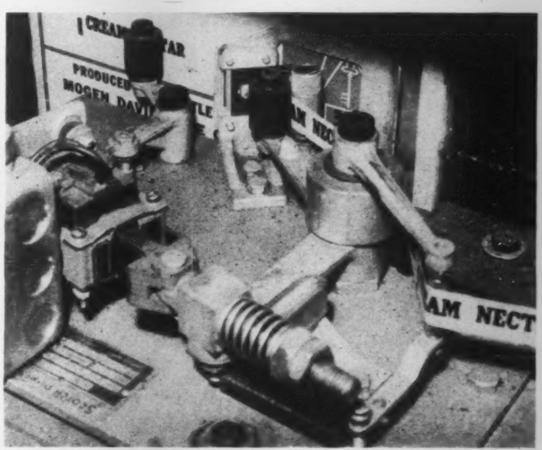
Courtesy, Lynch Corp.

Today, higher costs for almost everything that is used in the manufacture of the product—materials, direct and indirect labor, overhead, utilities, plant facilities, and production equipment—have forced industrial managers to take another look at the basic types of processing arrangements. The result is that more products are being made on integrated production facilities that eliminate the costly manual handling and orientation operations formerly necessary between processing steps.

In progressive companies, management has concentrated on beating cost increases and on achieving greater productivity through the application of automatic techniques at the points where the greatest savings can be made—component fabrication, assembly, and inspection lines. At the start of some of these automation programs, packaging costs were relatively small when compared to other production costs. As the degree of automation increased on the fabricating lines, the costs of fabricating the product steadily dropped while in many cases the packaging costs remained fixed or steadily rose, assuming a greater percentage of the product cost. The only way to reverse this cost trend for packaging is to apply the same degree of engineering skill and ingenuity to the packaging phase of operations as has been successfully applied to the component fabrication, assembly, and inspection phases of production.

▶ Integrated Manufacturing Processes

A chain cannot have a weak link at any point if it is to perform at its expected capability. By the same token, maximum productivity and cost reduction cannot be attained in a manufacturing system that includes a weak processing step. All manufacturing can be said to consist of eight basic processing steps: 1. Raw materials handling and processing. 2. Product or component manufacturing. 3. Inspection and quality control. 4. Assembling, combining, or mixing. 5. Performance testing. 6. *Packaging.* 7. Warehousing and storing. 8. Shipping and distributing. To attain the most effective automatic processing systems, the equipment that performs these basic steps must be interconnected by automatic handling equipment and interlocked by an automatic control system. To co-ordinate manufacturing processes with the other functions of the business enterprise, the processing steps are linked with the order, production control, and business data

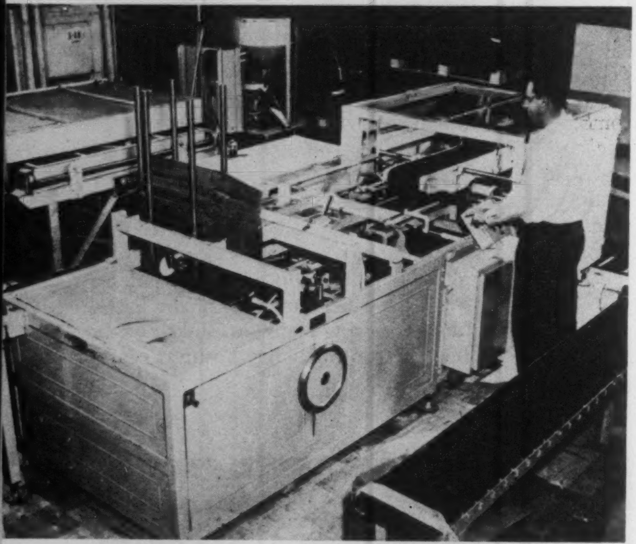


Courtesy, Minnesota Mining and Mfg. Co.

As part of an automatic line at Mogen David Wine Corp., a flat surface applicator applies pressure sensitive tape labels to cartons for identification of wine flavor in package. This type of taping machine can be installed along existing production lines. A photoelectric cell attachment controls cutoff of each label. Labeling after carton sealing can allow one standard carton to be used for shipping different products.

processing operations of the plant by suitable automatic data handling means.

Packaging, as one of the basic steps, is neither any more nor less important than the other seven steps. Insurance that it will be a strong link in the processing chain can be guaranteed if the packaging function is closely allied with the technology that has evolved as the catalyst of automatic manufacturing. This technology, manufacturing engineering, has been a key factor in producing a product to satisfy quality, volume, and cost standards that have a favorable effect on the marketability of the product. The manufacturing engineering function has evolved as industry was forced to give up its loosely connected manufacturing lines in favor of interconnected manufacturing systems. Under the old concept, specific engineering groups could adequately service various parts of the manufacturing line without seriously affecting the over-all output of the line. Machines could be shifted from one part of the line to another, production steps could be added or removed as required, equipment cycles could be adjusted, and personnel could be shifted up and down the line to plug gaps in the production cycles.



Courtesy, J. L. Ferguson Co.

Case opener-loader-sealer machine is used at AC Spark Plug Div., General Motors Corp. to reduce the amount of floor space needed for packaging. Knocked-down cases are fed from the machine's magazine and automatically formed and positioned. Product cartons are received directly from carton filling machines and are end-loaded into the case. Cases are then automatically sealed, compressed, and discharged to a conveyor for storage and shipment.

Today, flexibility is not as easily attained on the production line with the advent of the integrated automatic manufacturing system. Machines have become building blocks of a system and cannot be readily shifted to plug gaps in a poorly planned production process. "Before-the-fact" planning of production processes to eliminate "after-the-fact" corrections has demanded an engineering skill more diverse than the old engineering skill required by specific groups. The answer to this problem has been the development of the manufacturing engineering function which is responsible for manufacturing systems that will produce the product efficiently, economically, and without waste or nonproductive downtime. With automatic systems, product producibility has become as important as product design functionability.

In reviewing the procedures generally followed in the manufacturing engineering function, "before-the-fact" planning demands that the sequence of operations required to make the product must first be determined before the plan of production is implemented by specifying and installing necessary equipment. When the product being manufactured is considered to be the complete unit delivered to the buyer—including the package that the product is in, it follows that the package is comparable to one more detail or component of the final assembly. It must be procured from an outside supplier or manufactured on the line, fed at the proper time to an assembly point with the product, have the product inserted into the package, then be sealed, inspected, and transported to the shipping door. In this light, the manufacturing engineer is called upon to consider packaging of the product as one more step in the over-all sequence of operations, and provide for it accordingly. Organizations that continue to consider packaging operations as a separate specialty may be missing an avenue to untapped cost savings.

Design For Producibility

Although manufacturing engineering has no direct responsibility for the design of the product, it has become customary for management to insist on co-operative interchange of information between manufacturing engineering and product engineering during the design phase of a product. Where alternate design features present different problems of manufacture, choice of a feature can be influenced by an expression from the manufacturing engineer as to which design is more readily adapted to automatic manufacture. The same care and engineering studies that increase the producibility of the product must be tendered to ensure the producibility of the package. Just as manufacturing engineering has been given a strong voice in product design when questions of manufacture arise, it must also be given functional representation in the design of the package.

Certain aspects of package design are usually of little interest to the manufacturing engineering function. These pertain to the artistic measures such as sales messages, color, insignia, etc. Ordinarily, these features are determined by advertising, sales, and marketing groups of the company. Certain exceptions to this situation do occur. Some automated handling systems use code markings on the sides of packages to actuate sorting devices as the package passes a photoelectric reading station on a conveyor line. Certain products use packages with partially preprinted designs and add further identification markings as the package is filled with a particular product. In such instances, the size and locations of the markings must be co-ordinated with the design of the packaging equipment and must be compatible with the decorative markings on the package. These artistic measures are of direct interest to manufacturing engineering and must be compromised with package design to ensure producibility.

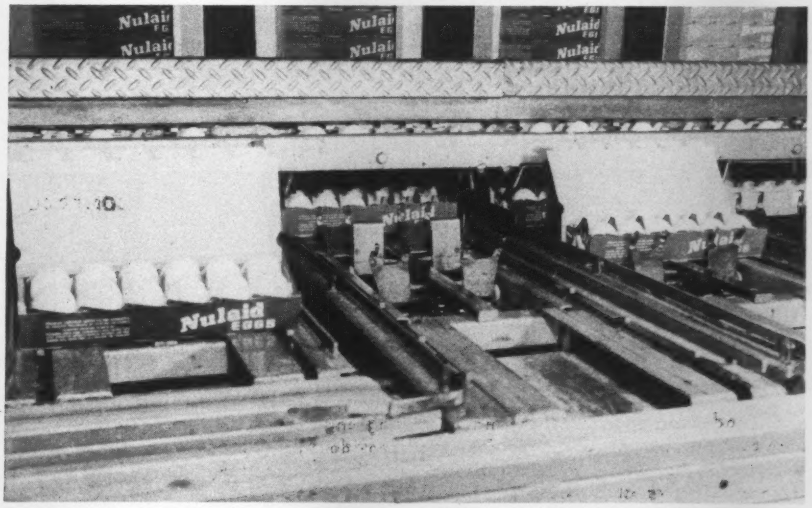
Certain other aspects of package design are generally of greater significance to the manufacturing engineer. These are pertinent to the dimensional characteristics of the package. Size, shape, method of closure, number of units per package and packages per carton may each have a bearing on the degree of automatic operations that can be included in the manufacturing process.

Conventional geometric shapes such as cubes, cylinders, and rectangular flats usually do not present any serious complications in engineering automatic packaging equipment. However, the package designer can conceive many odd-shaped and unconventional package forms in an effort to enhance the display function and salability of the product. These shapes may or may not require expensive adaptations of special equipment in order to handle them adequately on the integrated production line. In these cases, consultation of the package designer with the manufacturing engineer is a must. Otherwise, the advantage gained by unique package design may be paid for at a high price in equipment and processing costs.

As a primary part of his function, the manufacturing engineer has full knowledge of the capabilities of existing equipment in the manufacturing system. Under the old manufacturing concept, minor changes in package design could be handled by adding equipment here and shifting personnel there. With automated systems, such flexibility is not easily attained. Minor changes in design can affect the manufacturing system as much as major changes. The manufacturing engineer is aware of where such possibilities of flexibility exist in the automated system. Therefore, minor changes in package design should be treated with the same considerations for manufacturability as major changes. Close co-ordination between the package designer and the manufacturing engineer will enable the desired package change to be included in the automated line with minimum compromise.

Many times the method of package closure may be of little importance for the functional purpose of the package. Stitching, gummed tape, heat sealing, pressure sensitive tape, gluing, capping, etc., are available to the package designer as possible closure methods. However, as with other phases of package design, closure methods can have great significance in applying automated techniques to packaging. For example, in the plant of a large electrical products manufacturer, miniature lamp bulbs were packaged in a preglued die-cut tube. It had to be opened and the bulbs carefully inserted by hand. The package was redesigned for producibility and a flat tray package was developed. The new bulb retainer requires no cartonmaker's glue joint and is handled flat. Most important, the new design allowed machine loading of the bulbs into the tray. Much money is spent wastefully for excessive loading and closing labor consumed in poorly designed packages.

The importance of package design producibility can be summed up by referring to a statement by



At Poultry Producers of Central California, a co-operative egg marketing and feed supply association, eggs are graded and automatically packaged at a rate of 2 million eggs per day. Controlled by an electrical memory system, a conveyor carries each weight and grade egg to a particular carton station in the packaging machine. An egg carton, with lid held open, is positioned under the conveyor and a unit senses empty cells in the carton into which eggs are released from the conveyor. The carton is repositioned, and the second row is filled. Carton is automatically conveyed to a closing and coding machine.

Courtesy, Food Machinery and Chemical Corp.

Courtesy, Hinde & Dauch

In this case loader-sealer at Standard Oil of Ohio Refinery No. 2, wax slabs are automatically stacked 5 high and end-loaded into preprinted cases. The cases are sealed, compressed, and discharged to a conveyor leading to a palletizing operation. Wax slabs are conveyed to the packaging machine from other operations in another part of the plant.

Foster B. Whitlock, president of Ortho Pharmaceutical Corp. "The opportunity for automation in increased productivity is always present, as attested to by the fact that total employment in our packaging department over the last 5 years has decreased 13 per cent, while our sales have increased 62 per cent. This was accomplished by automating carefully and by paying close attention to package design so that our packages would lend themselves to good production techniques and still retain their own product individuality. The search for increased productivity through appropriate package design, methods' improvement, and automation is a never ending one, and one in which we all can find additional profit dollars."

▶ Package Standardization

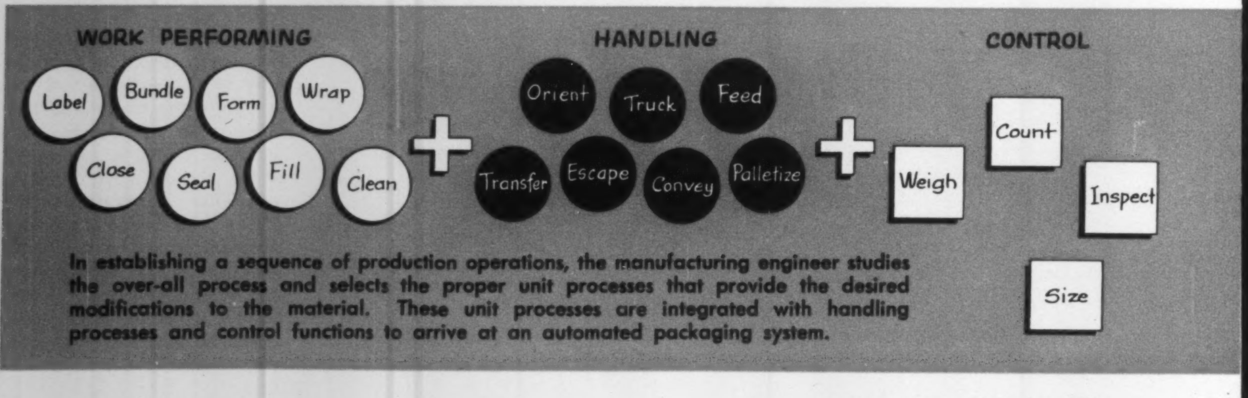
As important as package design is to the manufacturing engineer, he also is vitally concerned with package standardization. Since the product and package are no longer processed on highly flexible individual lines but rather in an expensive automated system, changeover from one product size to another can be quite complex. When one part of the system is tied up in changeovers, other parts of the system are either idle or are fed from system storage banks. The amount of set-up time required to prepare for a production run is often the determining factor as to whether an automated installation can operate at an economic advantage.

Machines that can handle different products may be limited with respect to the variety of packages that can be accommodated. To simplify setup, it is helpful to standardize on package size and shape as much as possible. Even though 20 different packages may have been advantageous in a complete product line, automatic production can be best served by weeding out poor sellers so that fewer types of packages will suffice.

An advocate of package standardization is Lee R. Srigley, superintendent, General Finishing Div., Parke Davis & Co., who said, "Little attention had been given to standardization of our product line insofar as the package was concerned. But with the advent of automatic machinery, and the building of integrated production lines, it became increasingly important to have such standardization. To do this we established as a basic premise that the unit container would be the controlling factor in package standardization, since in planning automatic lines, we build around the container size and shape."

▶ Packaging Processes

While it is important for the manufacturing engineering function to have a voice in package design, the primary objective of this organization is to engineer the production system and equipment necessary for the manufacture or processing of the product. In establishing the sequence of production operations, the manufacturing engineer thinks in



In establishing a sequence of production operations, the manufacturing engineer studies the over-all process and selects the proper unit processes that provide the desired modifications to the material. These unit processes are integrated with handling processes and control functions to arrive at an automated packaging system.

terms of unit processes, or operations to be performed upon the product. This thinking takes the form of a process planning sequence list that describes each modification to the material that is to take place. Such a list concerns the physical or chemical changes to the product and not the equipment that accomplishes these changes. Only after study of alternative processing systems are the various production machines specified to perform each of the required unit processes.

With respect to the packaging operations that may be required for product manufacture, certain unit processes are in common use. Some of these are: Form package, clean package, fill package, wrap product, bundle products or packages, close package, seal package, label package, case package, close case, and seal case.

These unit processes are interconnected with handling processes that are used to change the position of the material. Such processes may include: Orient, feed, transfer, escape, convey, palletize, and truck. To complete the system, the handling processes are supplemented by the required control functions such as measure and inspect.

A particular production line may include some or all of these work performing, handling, and control steps. An understanding of the various techniques used to accomplish each of these steps is essential to the successful planning of the production facility. Different product and package characteristics require that different subclasses of these processes be specified. The manufacturing engineer must be familiar with the basic considerations required to integrate each process step into the production line.

Form Package. Many times it is not economical to actually manufacture the package unit on the production line. In these cases the packages are purchased from outside suppliers or made in separate operations For example, metal cans, bottles, fiber containers, bags, sacks, and many forms of boxes fall into this category. Other packages are partially made off the line and then are set up as a step of the process. These include knocked-down boxes and cases that are received and stored in the flat form to conserve storage space. Other packages such as foil and film bags, waxed paper liners, and blister packs may be made from coil stock as a step of the production process.

Clean Package. A particular process may require complete soaking, washing, and drying of the container even to the extent of making it sterile. Other conditions may require merely removal of loose particles by inverting the container and allowing the foreign matter to fall out. This may be assisted by brushing or air blast action.

Fill Package. Filling may be a transfer type motion that pushes a unit sideways into the package. The package may be placed over the product, or the product lifted and placed into the package. The filling method is usually very closely associated with the requirements of measuring and feeding.

Wrap Product. This process is often similar to the package forming process insofar as the requirement is to form a package around the product. This usually means enclosure of the product with a covering made of sheet material such as wrapping products with rustproofing paper, wrapping bread, and enclosing frozen food packages.

Bundle Products or Packages. To combine a group of products or packages together for shipping or other purposes, a bundling process may be required. This is similar to wrapping except that the medium is usually a strip, strap, tape, or wire. Tubing or pipe products may require bundling with tape. Newspaper stacks may be bundled with wire. Groups or individual boxes may be secured with steel strapping.

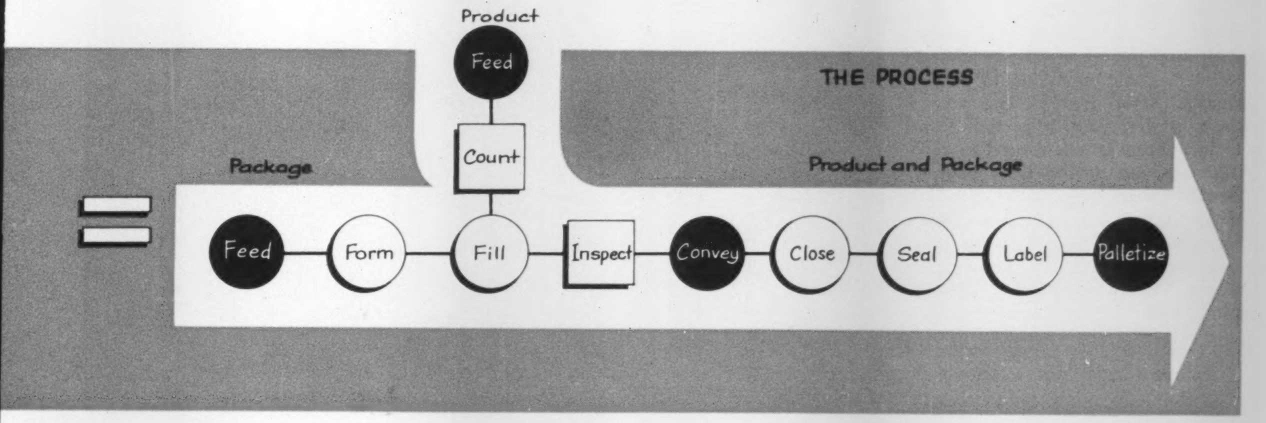
Close Package. Once the open package is filled, it may be necessary to perform a closing operation. This may involve folding the package end, tucking a flap, adding a lid, screwing a cap, or in some way completing the enclosure of the product.

Seal Packages: The character of the sealing operation is determined primarily by the type of sealant method used. Common methods use: Gummed and pressure sensitive tapes, wax, glue, plastic, bend-over tabs, staples, clips, and stitching. The material may be applied to the package prior to processing on the line, or it may be applied as an operation on the line.

Label Package. The product and package design may require the addition of labels as part of the production process. These may take the form of individual paper labels or a continuous tape applied to the package. Information may be imprinted on the package by marking devices that operate as part of the line.

Case Package. Often it is required that a group of packages be placed in a case to establish the unit size for shipping. This process is comparable to the package filling process except that the product being cased is generally one that has previously been packaged.

Close Case. With corrugated carton type cases this



usually involves closing the flaps. On wooden boxes, it means applying a lid or closing a wirebound lid.

Seal Case. Corrugated carton type cases are usually sealed by gluing, stapling the flaps, or by applying steel strapping. Wooden boxes may be nailed or steel strapped.

Handling operations that are involved in packaging processes are generally of the same nature that the manufacturing engineer utilizes in any process.

Orient. Both the product being packaged and the package itself must be oriented prior to the actual packaging operation. Packages not purchased in some oriented form may require an unscrambling operation to get them in proper position for filling. Grippers, vacuum devices, and electromagnetic means may be used to reposition packages as required.

Feed. Gravity, pressure, vacuum, auger, pusher, and various combinations of these means are used to feed packages into filling positions and products into packages. Magazine type feeders may be required to feed knocked down cartons into setup stations.

Escape. Many types of feeders require escapement devices to assure that only the desired material moves into the package at the time of actuation.

Transfer. Actual movement of product or package from one workstation to the next can be accomplished by transfer mechanisms that may lift, lower, or impart horizontal motion to the material.

Convey. Handling may require conveying of products or packages from one location to another. All types of pneumatic and mechanical conveyors are employed.

Palletize. Loaded bags, barrels, or cases may be palletized for ease of handling, storing and shipping.

Truck. Package units of various sizes (from pill boxes to pallets) may require trucking to storage or shipping sites.

In addition to the regular types of automatic control systems used to make the processing and handling equipment perform automatically, the manufacturing engineer is interested in certain control functions important to the packaging of products.

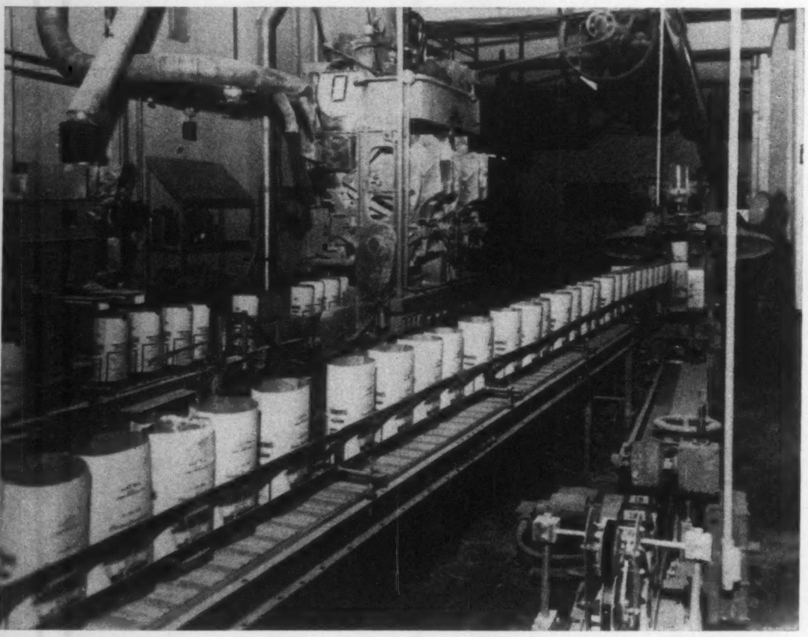
Measure. To divide the product flow into the appropriate unit size for packaging, some measurements must be made. These may take the form of counting, weighing, or volumetric sizing. The question of accuracy of these measurements is assuming greater importance in large quantity production runs. Regulations and reputations require that the customer not be shortchanged by underfilling of packages. Costs of operating require that overfilling be kept to a minimum. As speed of operation increases, the accuracy problem becomes more difficult.

Inspect. To control precisely the packaging process, it is often considered wise to incorporate inspection operations in the line. Check-weighing stations can detect the absence of a component of fabricated product or the under or overfilling of packages. X-ray, photoelectric, limit switch and other sensing means can be used to verify that the packaged product conforms to specifications.

▶ Process Applications

In addition to the unified approach to production lines that occurs when the manufacturing engineer assumes full responsibility for engineering the packaging operations, there is a converse effect that takes place. As the techniques of packaging become part of his repertoire, the manufacturing engineer applies, to other parts of the line, unit processes that have been highly developed by packaging specialists. An automated installation for putting pharmaceutical tablets into vials and applying screw caps may contain all the engineering know-how required to devise an assembly machine that puts product components on a stud and secures them with a nut.

The unit processes, handling, and control steps



Packaging line at Shawnee Milling Co. is capable of filling 5-lb bags with flour or meal at speeds of 40 units per min and a weight tolerance of plus or minus 0.2 ounce. Empty bags are automatically fed from magazines, opened, and partially filled, two at a time, on the feeding-filling machine (center background). Bags are then conveyed to duplex fill-weigh scale (left) which dribble-feeds material to complete filling to proper weight. After contents are settled on a shaper (out of picture, lower left) bags are conveyed to closing machine (right background). Sealed bags next move through dryer to coding machine (right foreground). The completed units are conveyed to a baler and baler sealer for packaging into a shipping unit.

Courtesy, Bemis Bro. Bag Co.

required to put fine-mesh powder into vacuum tubes, or to dispense silica gel into refrigerator defrosting units on the production lines compare quite closely to those of measuring, feeding, escaping, and package filling used for packaging processes. Checkweighing principles developed for packaging lines have been applied to weight balancing operations in the manufacture of automotive connecting rods. Package closing techniques find application in the manufacture of match books and paper products.

This awareness of the likeness of packaging processes to other processing steps can be beneficial in both directions, and in the long run can be expected to benefit all types of processing including packaging.

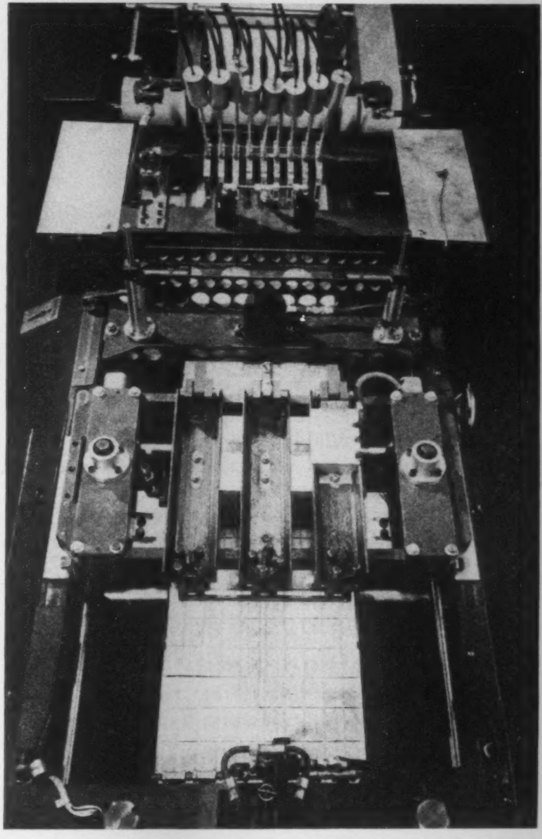
Another advantage to the growing "package awareness" of the manufacturing engineer is that he can discover paths to cost reductions by specifying the type of package his company's vendors must use to ship incoming material. Recognizing that the package can do double duty as a means of shipping and also as a means of orienting the product, the manufacturing engineer can influence the selection of packages for purchased material. In order that the package be compatible with the automated production facilities he may insist that coil springs be received in tangle proof trays, that beer cans come on wrapped pallets, that resistors be on ribbons of tape, or that bulk granules be in unit containers.

For example, at the Point Breeze Works of Western Electric Co. Inc., manufacturing engineers were concerned with the problem of handling millions of pounds of polyethylene granules that would be consumed annually in a new cable insulating program. Prior to the new program, all plastics used at the plant were received in 50-lb paper bags, palletized at the truck or railroad docks, and then placed in raw materials storerooms. As required, these materials were trucked to operating areas and, in most cases, hand emptied into extrusion machine hoppers.

In order to eliminate high handling costs of the polyethylene granules, to protect the plastic from contamination due to moisture and foreign materials, and to eliminate material losses due to damaged packages, Western Electric adopted the use of large, portable neoprene-and-fabric containers, holding 9400 pounds of material, as the standard incoming package for the plastics. These containers, leased from U. S. Rubber Co., are loaded and sealed at suppliers' plants and shipped via rail or truck to the Point Breeze Works. Upon arrival, the containers are stored outside the plant and only moved into the plant when plastic is needed on the extrusion line. A lift truck moves the containers into the plant and installs them onto cradles which are connected by pneumatic conveying systems to the extrusion machines located as far as 720 feet from the materials receiving area. Eleven cradles are used in the system, and each cradle setup can feed plastic to as many as six extrusion machines.

By adopting a new package for incoming raw materials in combination with an automated materials handling system, Western Electric gained many plus values over the original manual handling system. The new package reduced the cost of material due to bulk handling. Waste from broken bags has been virtually eliminated. Handling in congested areas around production machines has been eliminated. Outside storage space for incoming plastics releases indoor warehouse space for other products. Substantial savings have been realized by completely eliminating manual handling from the operation.

This example illustrates that the packaging function prior to the actual production line can be just as important and produce as sizable economies as improved packaging of the product after manufacture. Many times, a company will be all too willing to accept a supplier's package as the best available and consider that changing the supplier's package is out of his realm of operations. This outlook is out-of-date. Many suppliers are willing and anxious to change their package design to fit in with a manufacturer's production line.



Courtesy, General Electric Co

Blister packaging machine at General Electric Co. heat seals approximately 18,000 flashlight lamps per hour onto preprinted cardboard backing strips. The machine, designed and built by Packaging Industries Inc., packages ten lamps at a time on each strip. After heat sealing plastic to the backing strips, the machine perforates the strip between lamps to facilitate the removal of individual lamps. A trimming operation sizes the completed packages for insertion in self-display cartons.

Selecting the Equipment

After study of different processing proposals, the manufacturing engineer selects (usually with the help of top management) the process sequence to be used for the production line. Once this has been determined, a flow chart of processing, handling, and control operations can be used as a guide in specifying all equipment requirements for the process.

Because the process determination may depend to a degree upon available equipment and the selection of equipment depends largely on the requirements of the process, it can be seen that the manufacturing engineer must have a sound knowledge of the packaging equipment already developed and offered for sale. This know-how serves as a background for the determination of which operations can be combined into one machine, which can be readily performed automatically, and which are best accomplished manually. Equipment on hand or otherwise readily available to the production department may influence this planning.

The equipment builders who specialize in packaging machines have provided automatic equipment to perform all of the unit processes mentioned previously. Many machines offer various combinations of these processes. The manufacturing engineer must select a group of compatible equipment and arrange for its connection by handling devices and an interlocking control system. Where machines, or combinations of machines, that accommodate his plan are not available, he may decide to go to special designs in order to achieve the desired results.

Such special designs may be only modifications of existing machine designs in order to integrate previous developments into the production line. On the other hand it may involve complete specials for which no previously designed equipment exists. At this juncture the manufacturing engineer's knowledge of the packaging equipment field becomes invaluable, for he would certainly not want to duplicate the development of a technique that had already been perfected. Consultants specializing in the packaging field are often helpful here.

Make or Buy

Standard commercial packaging equipment can almost always be purchased and installed for less capital investment than is required to design, construct, and prove-in custom engineered equipment. However, standard machinery is commonly designed to be able to function satisfactorily in a large number of different manufacturing situations and may not suit some specific purpose required by the manufacturing engineer. In many cases, commercial machinery requires many changes for adaptation to integrated control systems in operation on other parts of the line, and it is cheaper in the long run to design and build custom equipment. In other cases, the initial cost of commerical packaging equipment is relatively low when compared with custom equipment, but by the time adequate safety guards are added and changes in design are made to meet local and plant installation codes, the commercial machine cost may easily approach the custom design cost. Many times, in order to meet the cost of competitive products in the same field, commercial machinery is built on lighter frames than are acceptable for custom equipment. This could mean more vibration, more maintenance, and less machine life than a more sturdily constructed design.

These factors must be considered by the manufacturing engineer when he is deciding whether to make or buy a piece of production equipment—packaging or otherwise. The final answer can only be made after careful evaluation of all evidence—both pro and con—that the manufacturing engineer can obtain from his many sources. If the answer is to design and build special equipment as opposed to buying standard commercial equipment, the manufacturing engineer assumes an additional risk of proving-in and de-bugging a new piece of equipment.

It must be remembered that in today's highly competitive markets the make or buy decision involved with the packaging phase of the business operation also includes the question of whether to make or buy the package. Manufacturing plants have increased premiums on floor space. Package storage facilities are a problem. Container manufacturers have long recognized this situation and been progressive in their shipping and delivery schedules and procedures. Considerable effort is put forth to supply the customer with the package he needs when he needs it.

However, for reasons of cost, large manufacturers who have formerly purchased their package, have been looking in increasing numbers to the possibility of making the package for themselves. Paint companies are making their own pails, and breweries are making their own cans. Depending on the type of package, this trend can involve the need for expanded production facilities in the manufacturer's plant. The decision to make or buy the package must take into account all of the pros and cons of manufacturing facility expansion and requires that manufacturing engineering personnel participate in the cost studies involved.

Where a company develops the know-how to devise its own automatic packaging machinery, both for making packages and for packaging products, the ingenuity involved in unique design features may spell the difference required to be ahead of the field in manufacturing costs. This same ingenuity might be applied to using commercially available packages and machines in such a way as to create the same result. No matter which way the decision goes, one key to reduced manufacturing costs is the automation of manufacturing operations from receiving dock to shipping door.

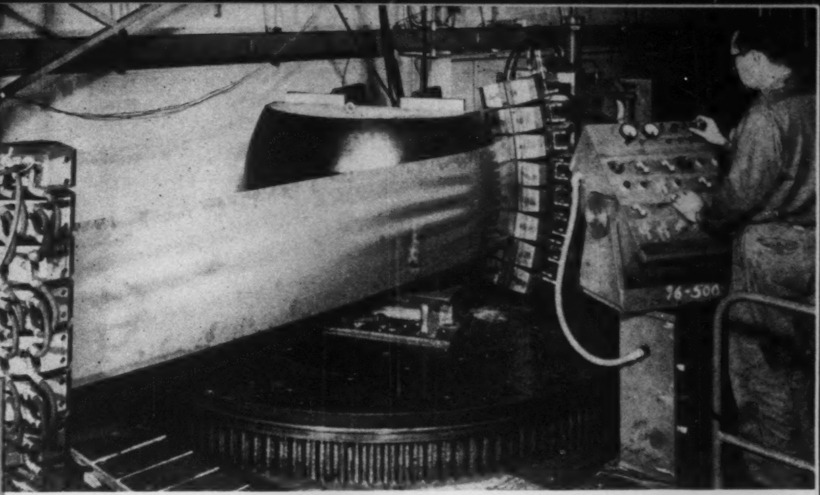


Fig. 1—Radial forming machine built by Cyril Bath Co. stretch forms metal stock around die on rotary table. Work is gripped at its ends by hydraulically operated clamps. Automatic controls sense yield point of material and control forming process as table carrying die and one set of clamps is rotated.

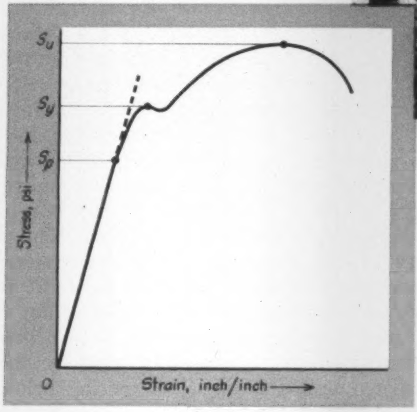


Fig. 2—Stress-strain diagram indicates important points in behavior of ductile metal as tension is applied: S_p, the proportional limit, marks maximum stress at which stress and strain are in the same proportion as at lower stress levels. S_y, the yield point, marks stress at which considerable increase in strain begins without an increase in stress. S_u, the ultimate tensile stress, is the maximum stress reached before the metal ruptures. Stretch forming process operates in region of yield point.

YIELD POINT CONTROL

AUTOMATES STRETCH FORMING

STRETCH FORMING of metals is gaining impetus as a production process. One of the reasons for increased popularity of this technique is the development of automatic controls that constantly monitor the forming process and make critical adjustments. A stretch forming machine equipped with automatic controls can produce more-uniform, higher-quality parts than can a manually controlled machine. In addition, metals which are difficult to form manually because of narrow stress-strain ranges of workability can be formed easily with automatically controlled machines. The so-called "exotic" metals used extensively in missile production are examples of materials that are difficult to stretch form with manual control.

Exotic and conventional metals are being formed on a production basis with a rotating-table type machine, *Fig.* 1, built by Cyril Bath Co. The automatic controls were designed and built by Assembly Products Inc.

Metal blanks to be formed in the machine are first clamped at their ends by two sets of hydraulically operated jaws. One of the jaw sets is mounted on the rotary table of the machine; the other set is attached to a hydraulic cylinder. Operation of the hydraulic cylinder, with the table held stationary, applies initial tension to the material to be shaped. At this time, the forming die is in a position where it does not contact the blank.

Tension is increased until the metal is stressed to its yield point. Tension is then dropped slightly by the automatic controls. This is done to prevent fracturing of the metal blank as the die is rotated rapidly into contact with the blank.

The forming operation is accomplished by rotation of the table carrying the die and one set of clamping jaws. Stress during forming may be set at the yield point or slightly above or below this value. At the end of the forming run, the table stops automatically. The operator then switches the controls to *Manual* and depresses a pushbutton that drops the pressure on the hydraulic cylinder to zero, thus relieving tension on the blank. The part is removed and the machine is ready to receive and process another blank.

The circuit for measuring yield point of the metal operates by sensing the point at which considerable elongation occurs without appreciable increase in tension. This method is based on the definition of yield point, *Fig.* 2.

A special load cell, mounted on the piston of the hydraulic cylinder, *Fig.* 3, senses tension in the blank.

Developed by Cyril Bath Co., the load cell operates by changing electrical resistance in accordance with applied tension. The ac signal from a bridge circuit of which the load cell is a part is amplified and rectified so that an electrical analog of tension is developed having a range of zero to 10 volts dc.

Elongation is measured directly by a potentiometer that is coupled mechanically to the piston of the hydraulic cylinder. Increases in the distance between the clamping jaws as tension is increased—reflecting elongation of the taut workpiece—rotate the shaft of the elongation potentiometer. The potentiometer provides a dc voltage that is proportional to elongation.

Rates of increase of the two analog signals—representing tension and elongation—are compared in a rate detector. Output of the rate detector is fed to center-scale Meter Relay 1, *Fig.* 3. As long as the voltages increase equally, the pointer of the meter relay remains at center scale. When the elongation signal increases out of proportion to the tension signal, however, the pointer moves to its high limit and locks. This action fixes the yield point by stopping Servomotor 1 that drives a yield memory potentiometer.

Meter Relay 2 has a dual function: 1. It indicates, in pounds, the tension being applied to the metal blank. 2. It shuts down the machine if the metal breaks. This protective action is initiated when the tension falls to zero and a contact on the indicating pointer locks with a contact on an adjustable pointer set at zero scale. The stop circuit includes a load relay which is energized by the meter relay to stop the machine. Restarting cannot be effected until the malfunction has been corrected.

Another zero-center meter relay is used to control tension during the forming operation. Meter Relay 3 monitors the output of a differential amplifier. Inputs to the differential amplifier include a signal from the yield memory potentiometer (yield point information) and a signal indicating actual tension. When these signals are equal, the indicating pointer of Meter Relay 3 is in the center of the scale. Too much or too little actual tension results in unbalancing of the pointer setting so that the pointer swings to a high or low limit contact and locks. Depending upon which limit contact is made, a relay provides voltage pulses of one polarity or another to operate Servomotor. 2. Rotation of the latter element is in a direction to automatically adjust the relief valve setting to correct tension and rebalance the meter relay pointer.

The differential amplifier circuit also controls initial buildup of tension to the yield point. When the controls are set to *Auto,* and a *Raise* pushbutton is depressed, the shaft of the yield memory potentiometer is turned by application of a predetermined voltage to Servomotor 1. As the potentiometer shaft is turned, a continually rising voltage is introduced to the differential amplifier. This results in unbalancing of the pointer of Meter Relay 3. Direction of unbalance is such as to call for increasing tension at a rate determined by the speed of the servomotor.

Other components in the automatic control circuit drop the tension momentarily after the yield point is found, and start rotation of the table. A provision is also incorporated in the controls whereby the operator can manually fix a level of tension below the yield point. When the controls are switched to *Auto,* this level will be maintained.

Advantages of the stretch forming process—reduced springback of formed parts, uniform work hardening of the material to higher strength levels, and reduced die cost (only one die, which can be made of relatively inexpensive materials, is needed)—are being exploited increasingly by industry. Reduced demands on operators, possible through use of automatic controls such as those described, promise to make these advantages available to more users.

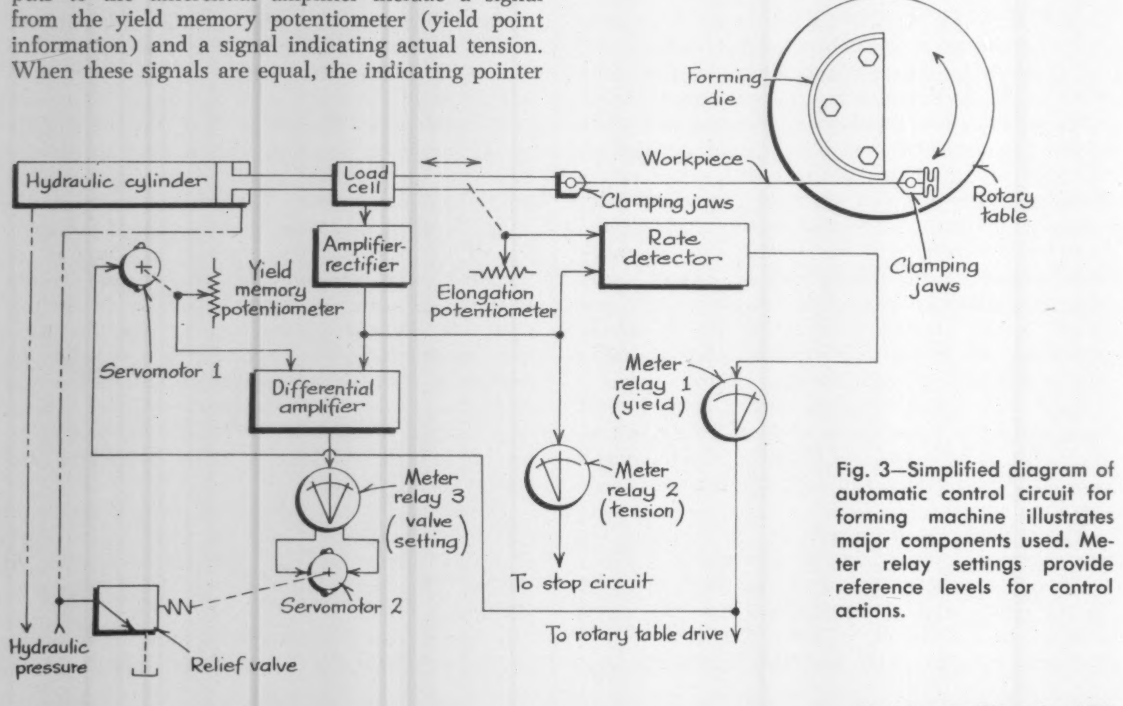


Fig. 3—Simplified diagram of automatic control circuit for forming machine illustrates major components used. Meter relay settings provide reference levels for control actions.

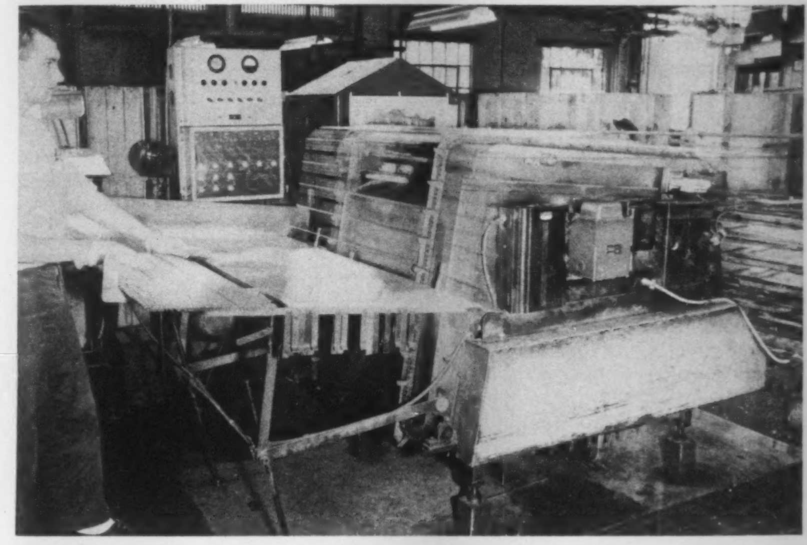


Fig. 1—View of input end of checkweighing machine shows manner of loading pharmaceutical glass tubes for automatic classification and sorting by weight. Over, under, and three satisfactory weight classifications are sensed.

SORTING GLASS TUBES BY WEIGHT

VOLUME of contents of glass ampules used by the pharmaceutical trades must be held within predetermined limits. These small containers, when filled and sealed, offer a convenient means of storing precisely measured quantities of vital medical substances such as insulin and antitoxin. Amounts of only 1 or 2 cc, representing single doses for hypodermic injection, may be involved.

One factor determining the capacity of an ampule is the ID of the glass tubing used in its fabrication. Because of the manufacturing techniques necessary in the production of this type of tubing, however, the ID is usually not controlled. Instead, OD is held to a tolerance of about 0.040-inch. The ID usually fluctuates within a given batch of tubing.

Because of these unavoidable variations in the ID of the tubing, it is general practice in the supplier industry to segregate all raw tubing before it is formed into ampules. Traditionally, an indirect method—based on manually weighing precut lengths of tubing and sorting them by weight—is used. This is permissible, since the weight of a given length of controlled-OD tubing reflects its wall thickness and hence, ID.

Tubing may be classified into over, under, and several categories of satisfactory weight. The ampule

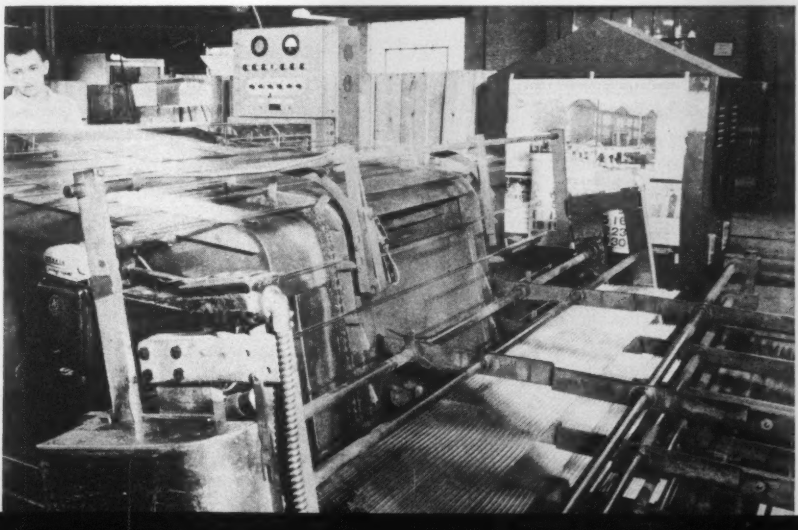


Fig. 2—Bank of storage racks, foreground, collects tubes according to weight categories. Individual tubes are pushed onto proper racks as the tubes are lowered by conveyor chains. Control panel, background, includes memory unit that retains weight information from the time tubes are weighed until they are transferred to racks.

forming machine is then adjusted individually for each satisfactory weight category, so that all of the ampules produced from good tubing will have the same, predetermined fluid capacity.

Several years ago, Kimble Glass Co., a subsidiary of Owens-Illinois Glass Co., decided to see what could be done to improve the manual weighing and classifying operation for its pharmaceutical glass tubing products. This operation, in addition to high costs, suffered from the possibility of human error. The breakage rate was also excessive.

An automatic tube weigher and classifier, *Fig.* 1, was developed to overcome the limitations of the manual process. In operation, an attendant places precut lengths of tubing on a ramp at the input end of the machine. The tubes roll downward to a loading point, and the leading tube is picked up by fingers attached to links of two parallel conveyor chains. Pairs of fingers project from the chains at spaced intervals so that succeeding tubes are picked up in order as they arrive at the loading point. Pickup rate is 58 tubes per minute.

After a short vertical rise, the tubes are conveyed across the top of the machine. At a point along the top, each tube is deposited on a weighing arm where it is held momentarily and the weight gaged automatically. Five weight classifications—over, under, A good, B good, and C good—are recognized. Information on the classification of each tube is transmitted electrically to a control panel. The control panel includes a memory unit that retains this information for later dispatching of the tubes to the proper collection points. The memory interval is about 15 seconds.

Because of a slight downward slope at the top of the machine, the tubes roll forward in this area until they contact the trailing edges of the preceding pair of fingers. When chains are redirected to a vertical position, the tubes are supported by these fingers.

Sorting occurs as the tubes are lowered by the chains at the output end of the machine, *Fig.* 2. There, the tubes are conveyed to a bank of storage racks. Each rack serves as a collection device for tubes of a given weight classification. Depending upon the signals from the control panel (in response to memory unit commands), each tube is routed to the proper rack. Transfer from the chain conveyor to the racks is effected by electrical release of trips controlling pusher arms.

When a sufficient quantity of tubes of a given satisfactory weight classification has been accumulated, the ampule forming machine is adjusted to accommodate that type of tube. The forming machine is then readjusted for the next good category, so that all of the ampules of a given size will have the same capacity.

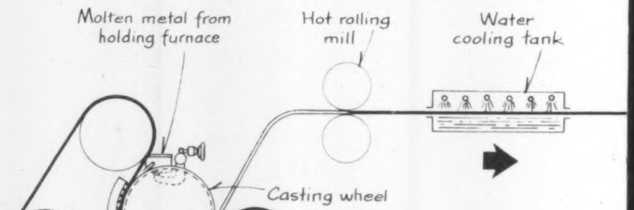
Benefits of the automatic tube weighing system, which is based on an Exact Weight Scale Co. automatic checkweighing setup, have been numerous: Greater weighing accuracy, less chance for error, lower cost, and a 5 per cent reduction in breakage compared with manual operation have been realized. These advantages are available to other users who weigh and sort discrete items.

CONTINUOUS CASTING LINE PROCESSES ALUMINUM STRIP

CONTINUOUS CASTING, hot and cold rolling, and coiling of aluminum strip are accomplished in an integrated production line developed by Lobeck Casting Processes Inc. The setup, *Fig.* 1, is suitable for use in captive shops of plants which use narrow-width aluminum and aluminum alloy strip. Representative products of such plants might be electric lamp bases, awnings, venetian blinds, containers, impact extrusions, and roll-formed sections.

The line, *Fig.* 2, is fed by a combination of melting and holding furnaces charged with scrap and ingot metal. A trough connects the holding furnace with the casting machine. Metal flow rates are accurately controlled by a valve.

The heart of the casting machine is a 5-foot diameter wheel which has a groove around its circumference. The depth and width of the groove determine the size of the rough "slab" produced. The groove is covered for casting purposes by an endless steel belt which bears on part of the casting



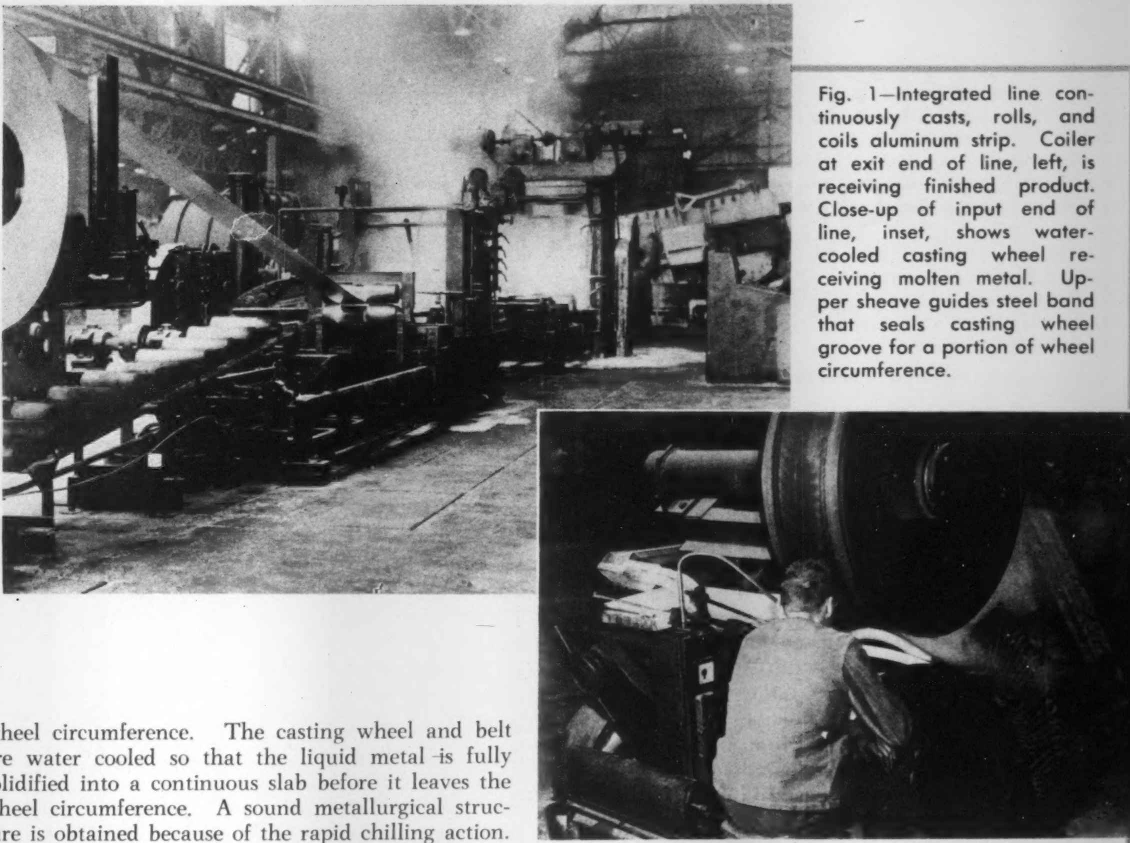


Fig. 1—Integrated line continuously casts, rolls, and coils aluminum strip. Coiler at exit end of line, left, is receiving finished product. Close-up of input end of line, inset, shows water-cooled casting wheel receiving molten metal. Upper sheave guides steel band that seals casting wheel groove for a portion of wheel circumference.

wheel circumference. The casting wheel and belt are water cooled so that the liquid metal is fully solidified into a continuous slab before it leaves the wheel circumference. A sound metallurgical structure is obtained because of the rapid chilling action.

The solidified slab next enters a 2-high hot rolling mill where it is reduced in gage. The resulting hot rolled strip then passes through a water cooling unit and enters a 2-high cold rolling mill for final sizing. A gage then continuously measures the thickness of the cold rolled strip. To obtain thinner gages of strip, the stock may be processed further in a tandem cold reduction mill at speeds up to 1000 fpm.

Two coilers, each equipped with a collapsible drum, are provided at the output end of the line. Coiling is continuous, with one coiler winding finished strip while the other is being unloaded. A flying shear is interposed between the cold rolling mill and the coilers to cut off the strip when a full coil is produced.

For some applications, the coilers are not required. For example, if the strip is to be used for impact extrusions, the stock may be introduced directly to a punch press and the necessary slugs produced continuously.

The entire line is electronically synchronized and controlled from a central console. In a representative installation, three men can operate the machine to produce $1/8$ x 8-inch, type 3003 aluminum alloy strip at a continuous rate of about 4 tons per hour. The coilers wind the strip into 16-inch ID x 50-inch OD coils weighing approximately 1300 pounds each. Several advantages are claimed for "do-it-yourself" production of aluminum strip products as opposed to purchasing: Lower raw material costs, reduced metal inventories, shorter lead times, and less dependence upon outside supplier conditions. Ability to remelt and use process scrap and metal from defective work offers additional plant economies.

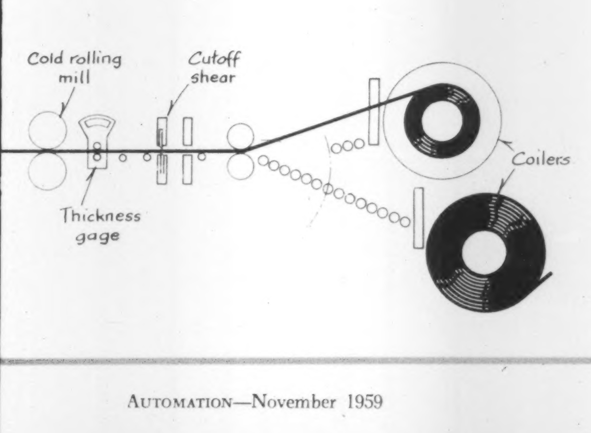


Fig. 2—Diagram illustrates path of flow of material as it is transformed from molten to finished strip form. Alternate arrangements include: Addition of tandem cold reduction mill to further reduce strip thickness, and substitution of blanking press for coilers when desired end products are slugs for impact extrusion.

METERING AND PROPORTIONING FLOW

WITH CONTROLLED VOLUME PUMPS

By **H. R. SMITH,** Product Manager, Milton Roy Co., Philadelphia, Pa.

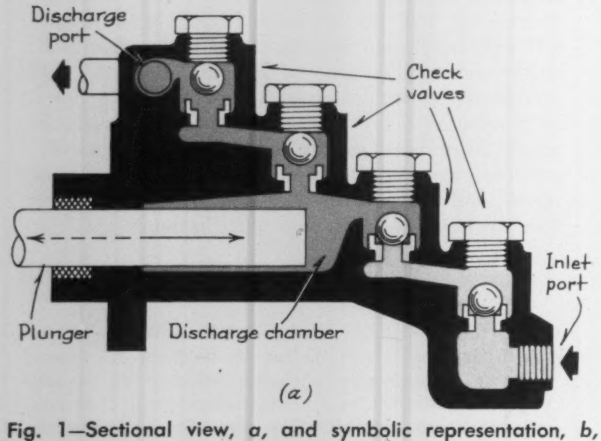
INCREASINGLY, production of uniform, high quality products by continuous processes calls for adoption of the techniques and methods of automatic control. Where controlled flow of fluids is involved—as in the paint, textile, fuel gas, food, paper, and chemical and petroleum processing industries—several methods have been devised to meter and control the output of pumps automatically. Control systems for these applications range from simple open loop to sophisticated closed loop types employing continuous feedback. Combination open and closed loop systems are also employed where their use is indicated.

For relatively small flows (up to approximately 45 gpm), controlled volume pumps, *Fig.* 1, are a frequent choice as the final control elements of such systems. These are reciprocating, positive displacement pumps that meter and pump fluids in measured volumes against positive pressure differentials between their inlet and outlet ports. Discharge pressures up to 25,000 psi may be generated.

Output of controlled volume pumps is a linear function of stroke length and rate of reciprocation. Therefore, control can be effected by changes in either or both of these variables. With combined stroke length and speed adjustment, it is possible to obtain accurate delivery rates over a total rangeability (ratio of maximum flow to minimum controllable flow) of 150 to 1.

Drives and Controls

The plunger of a controlled volume pump may be reciprocated by several means. If the stroke frequency is to be constant, a constant-speed rotary drive with a crank arrangement may be coupled to the plunger by means of a connecting rod. The drive motor may be an electric, pneumatic, hydraulic, steam turbine, or internal combustion type. For stroke



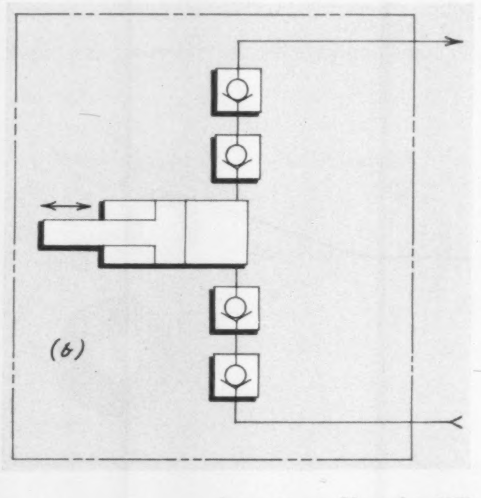


Fig. 1—Sectional view, *a*, and symbolic representation, *b*, of a Milton Roy Co. controlled volume pump illustrate principle of operation. Output of pump is a function of stroke length and rate of reciprocation of plunger.

Open loop, closed loop, and combination flow control systems are being employed in increasing numbers of continuous manufacturing processes. Choice of system hinges on the magnitudes and frequencies of process changes experienced. Whatever the type of system chosen, controlled volume pumps have proved suitable for use as the final control elements that perform the actual moving of process fluids.

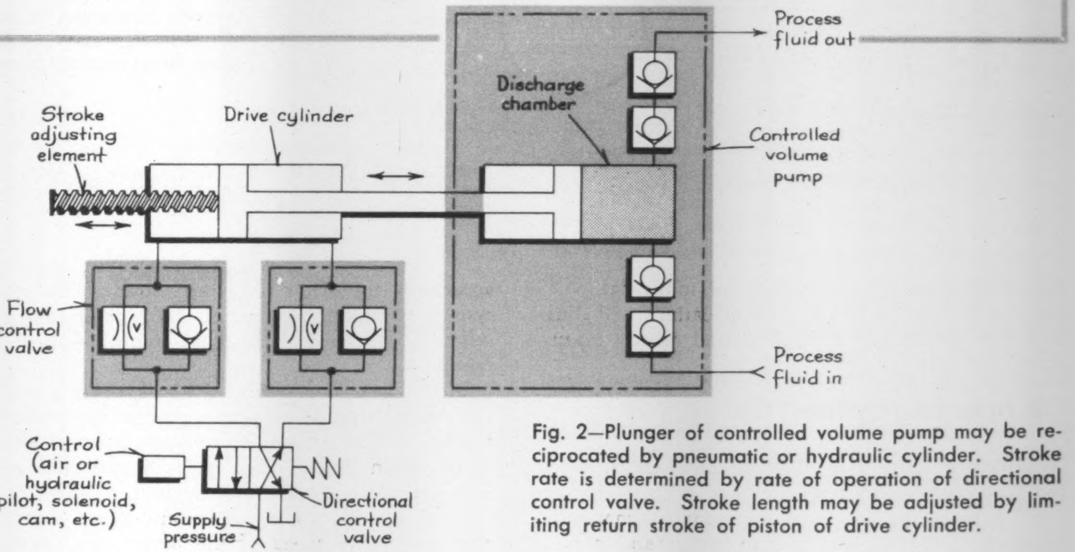


Fig. 2—Plunger of controlled volume pump may be reciprocated by pneumatic or hydraulic cylinder. Stroke rate is determined by rate of operation of directional control valve. Stroke length may be adjusted by limiting return stroke of piston of drive cylinder.

frequency control, a variable speed transmission may be interposed between the motor and crank mechanism where desired. Stroke frequency may also be varied by speed control of the drive motor.

Another method of providing reciprocating action is by a linear motor such as a pneumatic or hydraulic cylinder coupled directly to the plunger of a controlled volume pump, *Fig.* 2. In this case, motion is controlled by a directional control valve that admits fluid alternately to the blind and head end of the drive cylinder. Stroke frequency may be constant, as by regular operation of the valve by a timer, or tied in with some external occurrence reflecting process demands.

Automatic stroke length adjustments are easily made with either crank or linear motion drives. In the crank type, a reversible control element such as an air or electric motor is used. Rotation of the control motor shaft operates a screw and trunnion mechanism to transmit a desired portion of the total crank throw to the plunger of the pump.

When an electric control motor is used for stroke length adjustment of a crank-type drive, signals for control action originate in an electronic instrument controller which may be measuring temperature, pH, etc. A potentiometer mounted in the controller is connected to a balancer relay on the pump. This relay actuates the control motor in a direction to shorten or lengthen the pump stroke length according to process demands. A second potentiometer, geared to the control motor, supplies feedback signals to the controller potentiometer. Thus, accurate stroke length settings are effected automatically for varying process requirements.

With a reversible rotary air motor for the control element, stroke length adjustments of a crank-type drive may be made automatically in response to air signals from a pneumatic controller. Signals from the controller are introduced to the pneumatic circuit, *Fig.* 3, and used to control the direction and rotation of the air motor. Feedback is supplied mechanically by a linkage between the air motor output shaft and the pilot positioner. The air motor shaft turns 240 revolutions to effect a 1-inch change in pump stroke length. Positioning speed is 0.1-inch per second.

With linear-type drives, automatic stroke length adjustments are made by limiting the return stroke of the drive piston. This, in turn, limits the available stroke of the directly connected pump plunger. In one method, a pneumatic positioner varies the stroke length automatically in proportion to a controlled air signal from a pneumatic controller.

Controlled volume pumps are employed to control

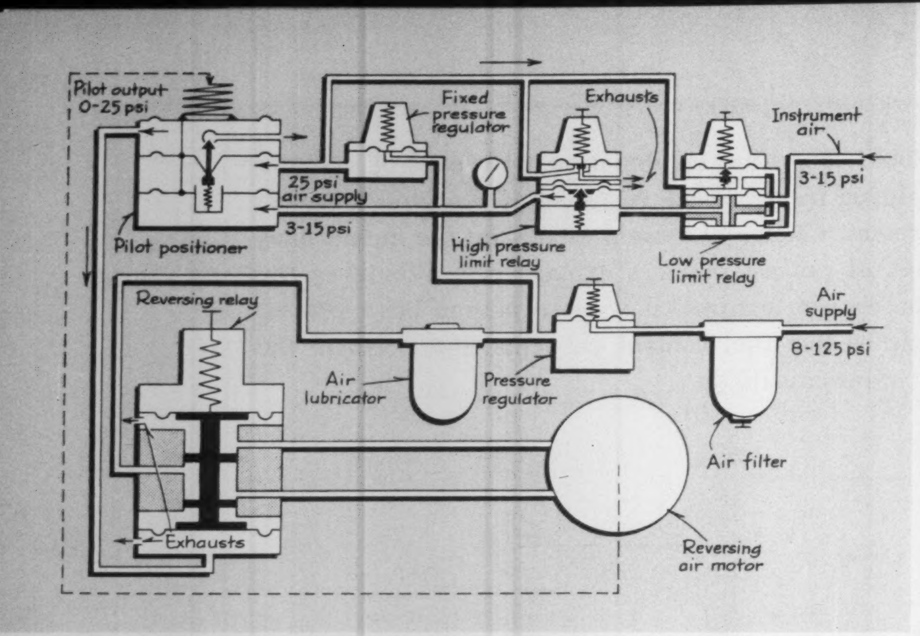

Pilot output 0-25 psi
Fixed pressure regulator
Exhausts
Instrument air
3-15 psi
25 psi air supply
3-15 psi
Pilot positioner
High pressure limit relay
Low pressure limit relay
Reversing relay
Air supply
8-125 psi
Air lubricator
Pressure regulator
Air filter
Exhausts
Reversing air motor

Fig. 3—Stroke of crank-driven controlled volume pump may be controlled automatically by pneumatic circuit of type diagrammed. Air signals from instrument controller, representative of process demands, determine direction and rotation of reversing air motor. Shaft of air motor operates screw and trunnion mechanism to transmit desired portion of total crank throw to pump plunger.

flow automatically in a variety of industrial processes. A description of typical applications will illustrate some commonly used drive and control means.

▶ Open Loop Systems

Automatic control of flow is most useful when the magnitudes and frequencies of process changes are too great for an operator to control manually, or when it is uneconomical to assign an operator to perform a monitoring function. Open loop control systems are used when it is possible to predict accurately the effect of pump capacity changes on system operation. Systems of this type depend upon inherent accuracy of the final control element, the pump.

In the open loop system of *Fig.* 4, stored chemicals are added automatically to a process stream in proportion to the amount of primary material flowing in the main line. A flow recorder-controller generates electrical signals proportional to flow. These signals are fed to an electronic speed controller that varies the speed of the pump drive motor in proportion to flow.

Another open loop system, *Fig.* 5, is used to control

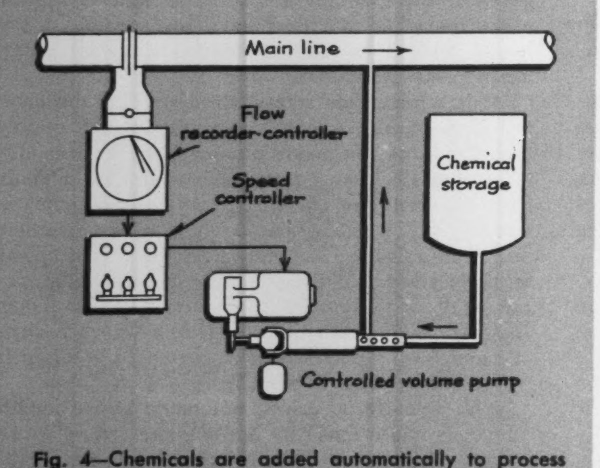

Main line
Flow recorder-controller
Speed controller
Chemical storage
Controlled volume pump

Fig. 4—Chemicals are added automatically to process stream by open loop control system. Signals indicative of primary material flow are generated by flow recorder-controller and fed to speed controller. Latter unit varies speed of pump drive motor to add chemicals in proportion to flow.

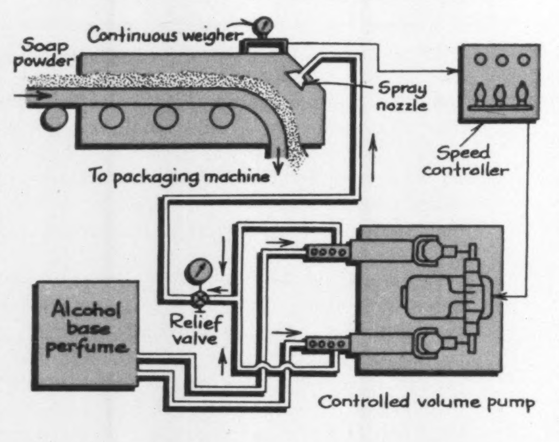

Soap powder
Continuous weigher
Spray nozzle
Speed controller
To packaging machine
Alcohol base perfume
Relief valve
Controlled volume pump

Fig. 5—Open loop flow control system automatically proportions amount of perfume sprayed on soap chips moving on conveyor. Weighing device senses weight of chips passing spray nozzle and governs speed of pump that feeds perfume to sprayer.

the amount of perfume sprayed on soap chips as they move on a conveyor. In this setup, a continuous weighing device senses the quantities of chips passing a control point. Signals from the weigher actuate a speed controller. The controller governs the speed of the pump motor to proportion the amount of perfume sprayed on the chips. Flow is in direct ratio to the weight of soap chips passing the control point. A dual pump arrangement is used to reduce the effect of pulsations at the spray nozzle so that the perfume is distributed evenly on the chips.

Ganged controlled volume pumps—operated from a common drive shaft—are often used in open loop systems as ratio controllers or process formulators. In one application, five pumps are driven together from a single variable speed drive. Flow of additives to a food product is controlled in proportion to liquid level in a surge tank. The ratio of each additive remains constant while the pump speed is slowed or increased. Changes in basic ratios are effected by manually adjusting the stroke length of each pump. This can be accomplished with the pumps operating.

▶ Closed Loop Systems

Closed loop systems are used where the main line flow is relatively constant, but the effect of pump capacity changes cannot be predicted. This is the case in a pH control system, *Fig.* 6. This system depends upon continuous feedback to regulate the final control element and thus maintain accurately the desired balance between acidity and alkalinity. A pH controller transmits signals to regulate the stroke length of the controlled volume pump automatically, increasing or decreasing the flow of control agent to the process as needed.

Another application of this system is in the control of exothermic reactions where temperature varies with the changing concentrations of a catalyst. Catalyst feed control can be maintained by an air-operated controlled volume pump with automatic stroke length adjustment. The pump determines the rate at which the catalyst is fed to a reactor, in response to signals from a pneumatic temperature controller.

▶ Combination Systems

In processes where the effect of capacity changes cannot be predicted and the main line flow is apt to vary over a wide range, a combination open and closed loop system is needed. This method is illustrated in *Fig.* 7. Here, an open loop variable feed system is combined with a closed loop pH control system. The final control element is a single controlled volume pump. A recording flow controller adjusts the pump stroking speed, while a recording pH controller adjusts pump stroke length.

Combined open and closed loop systems are also used in boiler water treating installations in which pH is controlled. Speed of controlled volume pumps feeding caustic is regulated in ratio to water flow rates. At the same time, the stroke lengths of the pumps are adjusted to meet process requirements by a pH controller. In other parts of such processes, controlled volume pumps in open loop systems control flow of sodium sulfite to make-up water and flow of phosphate to condensate return lines.

Controlled volume pumps are finding increasing application as the final control elements in automatic flow control systems. The ease with which flow can be changed—by adjusting speed, stroke, or both—qualify these components for use in open loop, closed loop, and combination flow control circuits.

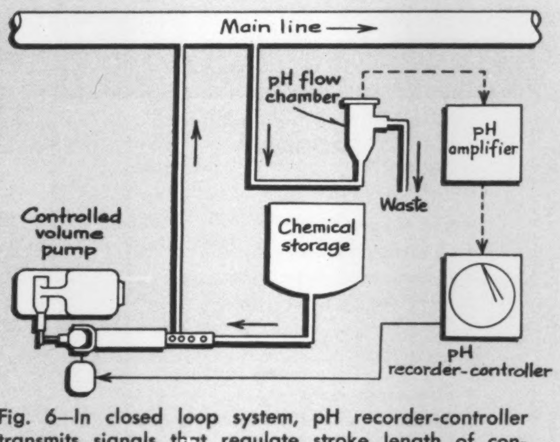


Fig. 6—In closed loop system, pH recorder-controller transmits signals that regulate stroke length of controlled volume pump to vary flow of control agent to process. Flow chamber and pH meter provide feedback signals reflecting actual degree of acidity or alkalinity of process stream.

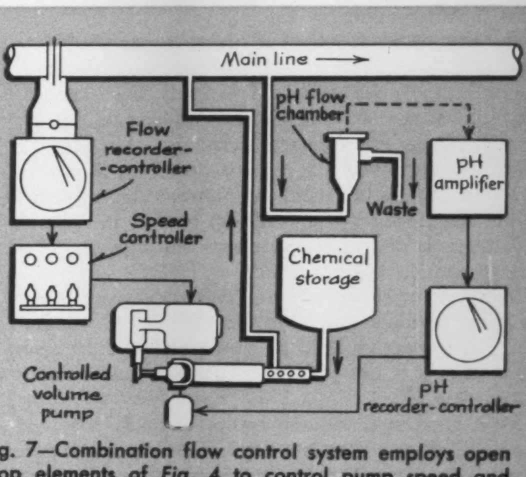


Fig. 7—Combination flow control system employs open loop elements of *Fig.* 4 to control pump speed and closed loop pH control system of *Fig.* 6 to maintain concentration of main stream at predetermined level. Combination systems are useful when main stream flow varies widely and effect of process changes cannot be predicted accurately.

This first article of a two-part symposium has been prepared by an authority from a firm specializing in the design of warehouses and allied facilities. His theme—consideration of all factors is required for successful automatic installations. In the second article, an equipment manufacturer will review existing installations that illustrate the practical application of modern concepts of handling packaged goods.

AUTOMATIC WAREHOUSING—THE CONCEPT

By **GILBERT I. ROSS,** Managing Partner, Ross & Company, New York, N. Y.

IN PLANTS, warehouses, and distribution centers throughout the country, packaged elements are today a very substantial part of factory and warehouse costs, both in terms of labor and overhead. It is quite natural therefore that, in many industries, management is studying possibilities of obtaining better efficiency in handling and storage.

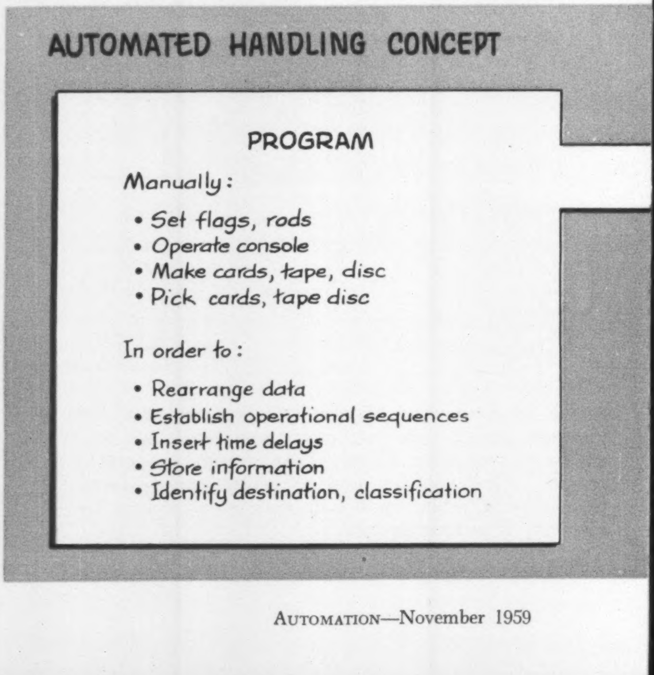
Such studies include possibilities of improvement through: 1. Better methods and techniques. 2. Better structures in which to operate. 3. More efficient space plans. 4. Modern mechanical handling equipment. 5. Automation.

Usually, it is found that these avenues of improvement are closely related and that consideration of one leads to the next, and so forth. For example, the physical characteristics of the building and equipment limit the methods and techniques that may be effectively employed. Or, approached from the other direction, the methods and techniques to be employed define the necessary type of equipment, its layout, and the most desirable size, shape, and type of structure to contain the operation.

Methods, techniques, equipment, layout, and building features are such closely related components of the design, and so greatly affected by each other, that it is not possible to consider one without considering all.

Even good methods and equipment will not yield their full efficiency unless there is an excellent space plan. This is extremely important. The structure, methods, and equipment are, in effect, bonded together by the space plan. They become factors of strength or weakness, depending on its adequacy and excellence. Frequently, modern methods cannot be adapted to obsolete buildings. Sometimes, however, mechanization may be just as effective in an old building as in a more modern one.

The complex assortment of methods, equipment, and techniques that are available today, and the many ramifications of the possible solutions to handling problems, have created an entirely new and unique planning and managerial problem for many industries. To find the best solutions to many problems there is need for co-ordinated talents in methods, handling and storage equipment, building de-



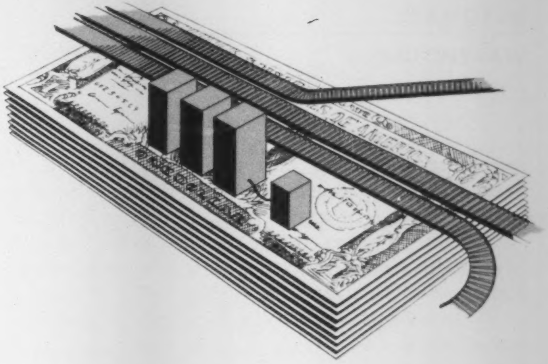
sign, space planning, paper work procedures, electronic control systems, and economics.

Major Emphasis

In considering materials handling for today's and tomorrow's plants and warehouses, the potentialities of automation are receiving much attention. Engineers and management have become interested in the feasibility of conducting various handling operations and the related paperwork with devices and machines rather than human brains and brawn. However, while certain patterns appear to be developing, the areas of economic feasibility have not yet clearly evolved. And, we seem to have come to the stage in the art of automatic equipment where the emphasis should be more on the "feasibility" aspect rather than on the glamour of "automation" as such.

With the advancements being made in the perfection of devices to provide input information, respond to the information, supervise, pick up, release, transfer, sort, accumulate, program, etc., there appear to be few handling operations that cannot be performed automatically by machine at some price. The challenge today is to conceive and design a system wherein cost will be in a proper proportion to its advantages.

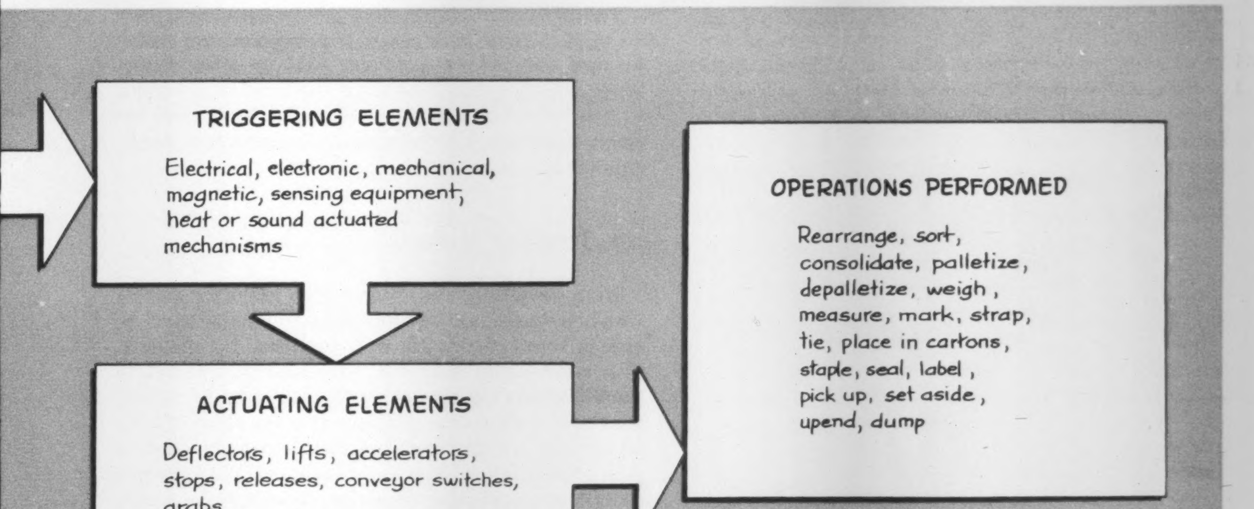
Through automation, costs may be reduced either by achieving high per manhour rates of productivity, or by providing capacity to handle peak loads without maintaining an excessive labor staff. Investment in plant conceivably may be reduced where automation permits the substitution of cheaper construction. Automated facilities, in some cases, may have more cubage with less floor space, may require less lighting, heat, ventilation, less in the way of facilities for personnel, and less expensive floors. On the other hand, unless care is taken in the engineering design of special buildings for such equipment, they may be so unconventional as to make it difficult to obtain mortgage financing.



- - - the challenge today is to conceive and design a system wherein cost will be in a proper proportion to its advantages.

Basis for Progress

During the past two decades, very substantial advances have been made in the art of handling packaged elements. New equipment and new techniques have evolved. Included in the progress has been wide adoption of the unit handling and storage concept; ability to handle larger and heavier loads; increased speed and range; conveyorization; and many items of equipment which serve as special tools to do a specific job better, faster, or safer.


TRIGGERING ELEMENTS
Electrical, electronic, mechanical, magnetic, sensing equipment, heat or sound actuated mechanisms
ACTUATING ELEMENTS
Deflectors, lifts, accelerators, stops, releases, conveyor switches, grabs
OPERATIONS PERFORMED
Rearrange, sort, consolidate, palletize, depalletize, weigh, measure, mark, strap, tie, place in cartons, staple, seal, label, pick up, set aside, upend, dump

The automated installation seeks to pick up where prevailing equipment and techniques leave off. It seeks to achieve its increment of efficiency by eliminating the man altogether, where economically advantageous to do so, or, in the alternative, by minimizing his task so that he can accomplish more. Sometimes also, it seeks to reduce errors or damage.

These objectives are being approached in the following ways:

1. Through the use of punched cards or tapes, computers, memory equipment, or other data processing equipment, to provide simplified time saving and space saving instructions to man or, better still, to various automatic machines and devices.

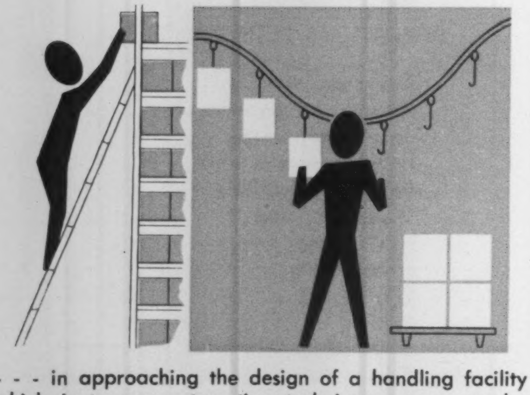
2. Use of identifying labels, tags, and marks on packages—or signals on carriers—which may be recognized by electrical, electronic, magnetic, or mechanical devices to actuate switches, deflectors, brakes, meters, recorders, etc.

3. Design and development of mechanical or electrical devices and equipment to pick up, move, rearrange, and put aside packages and loads of various kinds. Such equipment to be set in motion manually, or by machine instruction.

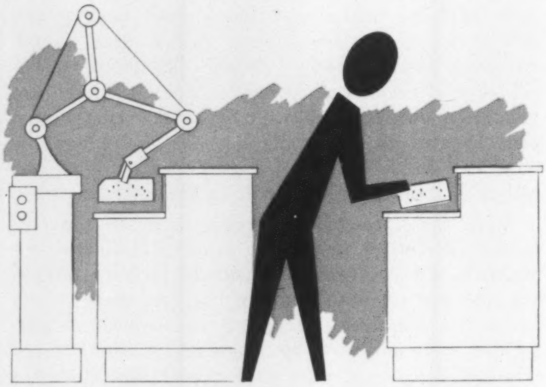
The range of operations which conceivably may be accomplished through combinations of modern equipment is indeed tremendous as is shown in the lead illustration, entitled "Automated Handling Concept."

For example, data fed into the equipment in the order in which the information is received may be automatically rearranged in such ways that it may be used more efficiently in the warehouse or distribution center. It may be used by man or by machine. It is possible to rearrange the instructions so that a worker may be directed to follow a predetermined path which is the mechanical minimum for the collection of items needed on a specific assignment. Not only may he be directed along the path, but signals of various kinds may be contrived to lead him directly from one station to the next.

The great capability of the memory devices conceivably may lead to the random storage of commodities and random access to them, thereby eliminating the need to hold open spaces for storing similar commodities in groups and eliminating the need for reconsolidating stock. Item rotation on a first-in, first-out basis may be ensured.



- - - in approaching the design of a handling facility which is to use automation techniques, one must be able to break completely with tradition.



- - - at present, many physical operations in warehousing can be handled more economically by man—and many control operations—more practically by man than by automated devices.

It is possible to contrive systems that will give priority to certain packages, that will temporarily bypass busy stations, and that will return later and accomplish numerous other necessary steps.

Punched cards, tapes, or memory equipment may be used to send impulses to trip mechanisms, which in turn may release packages held on slide chutes. Similarly, they may be used to send instructions to robot devices which travel to, pick up, and set down packages. The number of combinations available appears to be practically unlimited.

Tradition Is No Guide

In approaching the design of a handling facility which is to use automation techniques, one must be able to break completely with tradition. For example, it is conceivable that one technique of intra-plant handling may be applicable to rapid turnover packages and a distinctly different one for slow movers. Under one set of circumstances it is conceivable that pallet loads, as such, may be adapted to automated handling; in another situation, possibly the entire palletized principle may have to be discarded in favor of moving merchandise a case at a time and storing it on conveyors or slides.

In studying the feasibility of applying automatic features, usually it is found that certain operations or areas offer greater opportunities than do others. There must be a progressive exploration of automation techniques in each area. Frequently, the optimum result is found to be not a fully automated installation, but rather one that is automated in spots, and possibly mechanized in spots.

At present, many physical operations in warehousing can be handled more economically by man than by machine; and many control operations can be handled more practically by man than by automated devices. It is the job of the system designer to isolate such situations and to develop a system that will combine the advantages of manned operations with the mechanized and automated operations. Here, there is plenty of opportunity for ingenuity and know-how.

There are, of course, endless possible combinations of various mechanized, automated, and manual operations. A feasibility study will be more likely to justify the investment in an installation where there is an optimum balance of manual and machine operations, rather than a completely automatic system.

▶ The Future

As we look into the future, it is, of course, possible that changing trends or revolutionary developments in distribution, purchasing habits, packaging, and transportation facilities will completely alter our concept of a warehouse and distribution center. However, assuming that there are no revolutionary changes, it appears likely that we shall see more and more plant and equipment per employee, with resultant increases in output per manhour. It is logical to visualize the warehouse of the distant future as either a large single-story plant or a very special multistory building. Perhaps we shall see a return to the urban locations in newer type, large floor space, multistory plants, in which each floor shall be a single-story plant in itself, complete with all facilities.

It is conceivable that in the future cars, highway trailers, and trucks arriving at the docks will be equipped with self unloaders, or will carry cargo containers. Self unloaders could discharge their cargoes on large conveyor aprons which would transport them to inspection, classification, and marking lines. Unitized cargoes could be handled as unit loads or automatically separated, according to the system employed.

In some plants the merchandise then could be conveyed to stock storage locations; in others it could be automatically unitized, possibly without pallets, and sent as intact loads to stock locations via conveyor, automatic towveyor, or driverless tractor. Robots for putting stock into storage may be used.

Merchandise needed for process or shipment could be extracted from stock by the flick of a pushbutton or the signal from a punched card. It would flow on conveyors to classification lines, according to department, customer, routing, time of shipment, etc. If necessary, on the way it could be automatically weighed, date stamped, and labeled. Outgoing loads for vehicles would be unitized and transferred into the vehicle in minutes. All of these things can be done with present know-how and technology. All that is required is money, the distillation of plans, and the economic justification of the expenditures.

▶ The Challenge

In considering the possible improvement of a plant, warehouse, or distribution center, it is important that one should not be dazzled by the glamour or gimmicks of automation, nor paralyzed into inaction by fear of the rapid obsolescence of new equipment and techniques. Certainly an objective appraisal of the situation does not justify either attitude.

With the new tools of automation, the engineer has much greater opportunity than ever before to apply his vision and creativeness to improvement and progress. However, he must be a realist. Many plants can be improved substantially now—without automated equipment—simply by providing better layouts, better handling equipment, improved methods, and better structures. While we must keep alert to the potentialities of automation, it must not stop improvements along fundamental lines.

The basic problem is to perform certain handling services within certain permissible cost limits. Many elements go to make up such costs—including labor, fixed charges, and other overhead. Frequently, labor costs can be reduced through capital investment, which increases carrying charges. And so, we shall continue to have an incessant search for the optimum balance between investment costs and operating costs. One must select from the available facilities, methods, and techniques, that peculiar combination which will produce the best result for *his company.*

extra copies of articles available

In many instances a reader may desire to have extra copies of feature articles for further study, for specialized circulation within his plant, or for a reference library. As a regular service to readers, we will be happy to send copies of desired articles as long as the supply lasts. To obtain extra copies, just fill out one of the special business reply cards included in this issue.

EVOLUTION OF

COMPUTER CONTROLLED POWER GENERATION

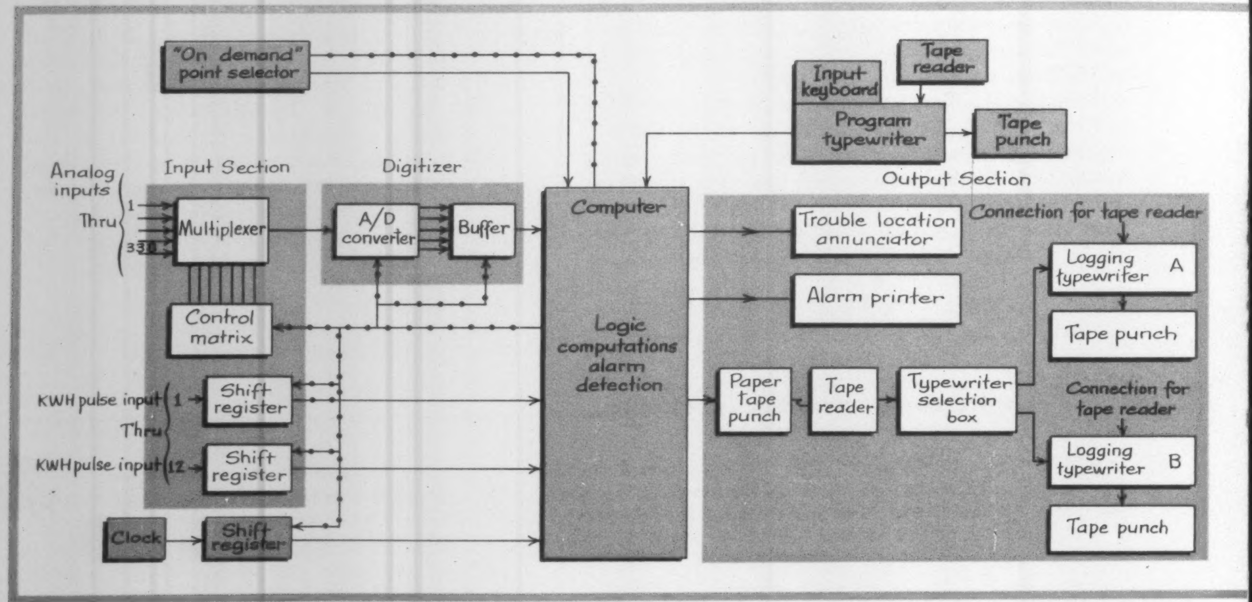
By F. A. RITCHINGS and W. A. SUMMERS
Consulting Mechanical Engr. Mechanical Engr.
Ebasco Services Inc., New York, N. Y.

BETWEEN Edison's first generating plant and the modern central station there are over 50 years of development of automatic devices to protect equipment against damage, to reduce personnel hazards, to improve reliability and availability, to improve efficiency, and to reduce operating manpower. The major developments include independent self-regulating loops, automatic protective equipment, and metering. These developments can be found in today's central steam electric station, which characteristically includes a single steam generator and turbine generator as a unit, with centralized control of several units from a control room. It is from this type of plant that the concept of the automatic station has evolved.

The basis for automation in a central station is information—and the methods by which it is obtained, manipulated, and utilized. The information transfer process can be analyzed more readily if the plant data are divided into three categories: Operating data, performance data, and historical data.

Operating data are guides for continuity of service and safety of equipment and men. They indicate: The ability to alter load; the status of equipment; the approach to structural, mechanical, or thermal limits of equipment; and other conditions that require limitations on load or rate of change of load, or shutdown.

Performance data indicate the economy of operation and provide information to determine which part of the plant is not performing at, or near, the optimum condition.


"On demand" point selector
Tape reader
Input keyboard
Program typewriter
Tape punch
Analog inputs
1
Thru
330
Input Section
Digitizer
Output Section
Multiplexer
A/D converter
Buffer
Computer
Control matrix
Logic computations alarm detection
Trouble location annunciator
Connection for tape reader
Logging typewriter A
Alarm printer
Tape punch
KWH pulse input 1
Thru
KWH pulse input 12
Shift register
Shift register
Paper tape punch
Tape reader
Typewriter selection box
Connection for tape reader
Logging typewriter B
Tape punch
Clock
Shift register

This article is based on a paper presented at the American Power Conference, Chicago, Ill., March 1959.

To many, the modern power generating station is already a model automatic installation—as indeed it is in comparison to many industrial plants. But progress will be served. Building on a relatively advanced base, power plant design has now entered an even more sophisticated stage aimed at the development of the computer controlled plant.

Historical data are of no immediate use but rather are collected for studies, long-term analyses, and predictions of required maintenance.

All three of these classes of plant data have a common requirement of manipulating raw data to convert them to useful information. But each of these categories requires somewhat different handling to achieve optimum utility. For example, operating information (and its associated function of equipment monitoring) requires continual scanning to rapidly and positively determine the approach to preset, fixed, or variable limits.

Performance data require accurate acceptance of numerous inputs followed by considerable computation and data reduction to meaningful numbers (such as heat rate, boiler efficiency, heater performance, etc.).

Historical data require accurate recording of specific information and averages; and identification of maximum and minimum values. These data must be identified with definite times and be recorded in a permanent, readily stored form.

▶ Two-Step Approach

The information process can be analyzed as a typical man-machine system. Such an analysis indicates that plant efficiency and reliability can be increased, and operating manpower decreased, by supplementing humans with machines. Practical considerations suggest that this can be accomplished in two steps: The first step involves data gathering, correlation, and calculation to produce information; the second step involves correlating information to produce decisions and execute these decisions.

The first step includes scanning, logging, and results computation. Several installations are in operation using this approach to control. One installation uses all-analog computation to produce a chart record of plant heat rate. Another uses analog scanning and comparison to set-points, digital logging, and some analog computation for heat rate. Another system consists of digital scanning and alarm detection, digital logging, and digital computation. As regards the latter type, Ebasco Services Inc. has co-operated with Daystrom Systems, Div. of Daystrom Inc., in the application of the Daystrom-built digital Monitor and Results Computer (MARC) at the Sterlington Electric Steam Station of Louisiana Power & Light Co., *Fig.* 1.

A digital computer system is particularly attractive for the task of scanning and logging operations. It is a competitively priced tool that is both versatile and flexible. In a digital system the same hardware can accomplish many functions, thus justifying the use of highest quality components. Such a digital system places into the hands of the operators a very useful tool to enable them to achieve optimum performance. However, the degree to which performance improvement is achieved is a function of how the operating staff utilizes the information that is given to them. The computer in this type of installation reports results; it will not do anything to correct the conditions or results reported. Improvements will be realized only to the extent that human operators take the necessary action. The question then naturally arises—why not let the computer control operations?

For a number of years, the requirements of an automatic plant have been studied by Ebasco. These

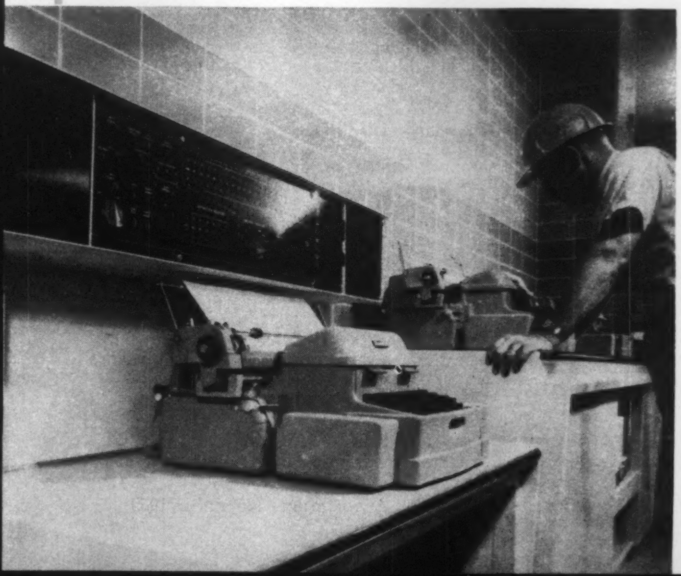


Fig. 1—Diagram indicates relationship of main elements in data reduction and alarm scanning computer system in operation at Sterlington Station of Louisiana Power & Light Co. Daystrom Systems, Div. of Daystrom Inc., built the Monitor and Results Computer (MARC) system. Picture shows actual computer input console and print-out desk for the system.

TABLE 1—Economic Comparison of Plant Operations

	1 Unit			2 Units		
Unit size—200,000 kw	Conventional	Marc	Automatic	Conventional	Marc	Automatic
INVESTMENT in Instrumentation and Controls						
a. Total	$ 1,000,000	$ 1,175,000	$ 1,700,000	$ 2,000,000	$ 2,200,000	$ 3,400,000
b. Differential	0	$ 175,000	$ 700,000	0	$ 200,000	$ 1,400,000
PLANT PERSONNEL						
a. Op/Shift Incl. Supr	5	4	2	6	5	2
b. Total Shift Personnel	21	17	9	25	21	9
c. Salary and Burden	$ 147,000	$ 119,000	$ 63,000	$ 175,000	$ 147,000	$ 63,000
d. Diff. Annual Cost	BASE	$ −28,000	$ −84,000	BASE	$ −28,000	$ −112,000
FUEL COST						
a. Differential Heat Rate	BASE	−25	−50	BASE	−50	−100
b. Differential annual Fuel Cost	BASE	$ −9,000	$ −18,000	BASE	$ −18,000	$ −36,000
TOTAL ANNUAL SAVINGS	BASE	$ −37,000	$ −102,000	BASE	$ −46,000	$ −148,000
CAPITALIZED VALUE OF SAVINGS AT 12.5%	BASE	$ 295,000	$ 820,000	BASE	$ 370,000	$ 1,180,000

COMPUTER MONITORED PLANT

THE APPLICATION of a Monitor and Results Computer (MARC) to a typical plant will provide for logging, scanning, and routine computation with immediate presentation of the results to the operating staff. This equipment will also average and integrate necessary values, minimizing the load on the engineering and clerical staff. It is capable of computing: 1. Net unit heat rate on both a present and hourly weighted basis, or more frequently if desired. 2. Optimum or best possible net unit heat rate for the load, circulating water temperature, and ambient air conditions then existing. 3. Net plant heat rate. 4. Steam and water enthalpies for heat balances. 5. Boiler efficiency. 6. Condenser performance. 7. Heat exchanger performance. 8. Turbine-generator performance. 9. Cooling tower performance, if a cooling tower is installed. 10. Auxiliary power overusage. 11. Average steam pressure, steam temperature, etc., for hour or day. 12. Integrated feed flow, gas flow, kwh, etc. 13. Meter corrections for calibration, error, temperature, and pressure. 14. Rate of change of metal temperature (e.g. turbine metal temperature).

Depending upon the amount of programming and memory available any of the above computations can also be referred to a norm to detect and advise the operator of his performance with respect to the desired performance.

Equipment can log any desired number of variables at preset intervals of about 5 minutes or greater (power, volts, amperes, reactive, flow, pressure, temperature, Btu, specific gravity, etc.) on output typewriters. Normal automatic log frequency is once per hour.

This equipment can scan for alarm any desired number of variables in addition to any or all logged or computed points at a rate of 5 to 10 points per second. Alarm settings may be automatically changed as a function of load or other variable. The scanning could include metal temperatures in the boiler and turbine, bearings on auxiliary equipment and main equipment, pressures, and other temperatures as well. The system will also check its own accuracy of computation and of digitizing each scan cycle by means of a built-in test problem with standard analog input.

It provides for manual initiation of printing, on the alarm printer, the absolute values of one to three independently selected variables, all variables, or all alarm set points. Alternately, manual initiation can result in printing of all logged variables on logging typewriters any time between normal log periods. A special switch permits multiple sampling of selected points in the same scan cycle, thus providing trend information at intervals of either seconds or minutes.

The machine can produce a varying current signal suitable for presenting trend information of selectable points on a miniature strip chart recorder. The same equipment can also provide signals to reset the set point of electric controllers.

The MARC system provides for some reduction in operating staff by elimination of hand-logged records and elimination of the necessity of calculating unit performance. It can provide some improvement in station performance by making calculated performance results immediately available to the operating staff while they can still correct operation and restore optimum conditions.

The system also: 1. Provides historical records including averaged or integrated values in readily usable form. 2. Improves record accuracy and reliability. 3. Aids in supervising operations. 4. Increases ability to operate the plant with substitute personnel when necessary. 5. Decreases probability of equipment outage by making available trends of performance. 6. Improves assessment of requirements for maintenance and reduces the necessity of periodic special boiler and turbine tests.

studies have indicated the need of a large amount of input information, many step-by-step instructions, and the necessity of decision-making equipment which could make different decisions based on many changing conditions and which could present results. It was obvious that if the digital computer proved reliable and trustworthy for the first step—scanning and logging—it was a tool with which to tackle the second step—complete automation.

Equipment for automation to the extent described in the box entitled "Automatic Plant" has been purchased by Louisiana Power & Light Co. for their 220,000-kw class, gas-fired, Little Gypsy installation. The equipment will be installed for trial operation in 1961. At Ebasco, studies are continuing on the automation of a pulverized coal-fired steam generator as work to date indicates areas of greater difficulty in the boiler operation.

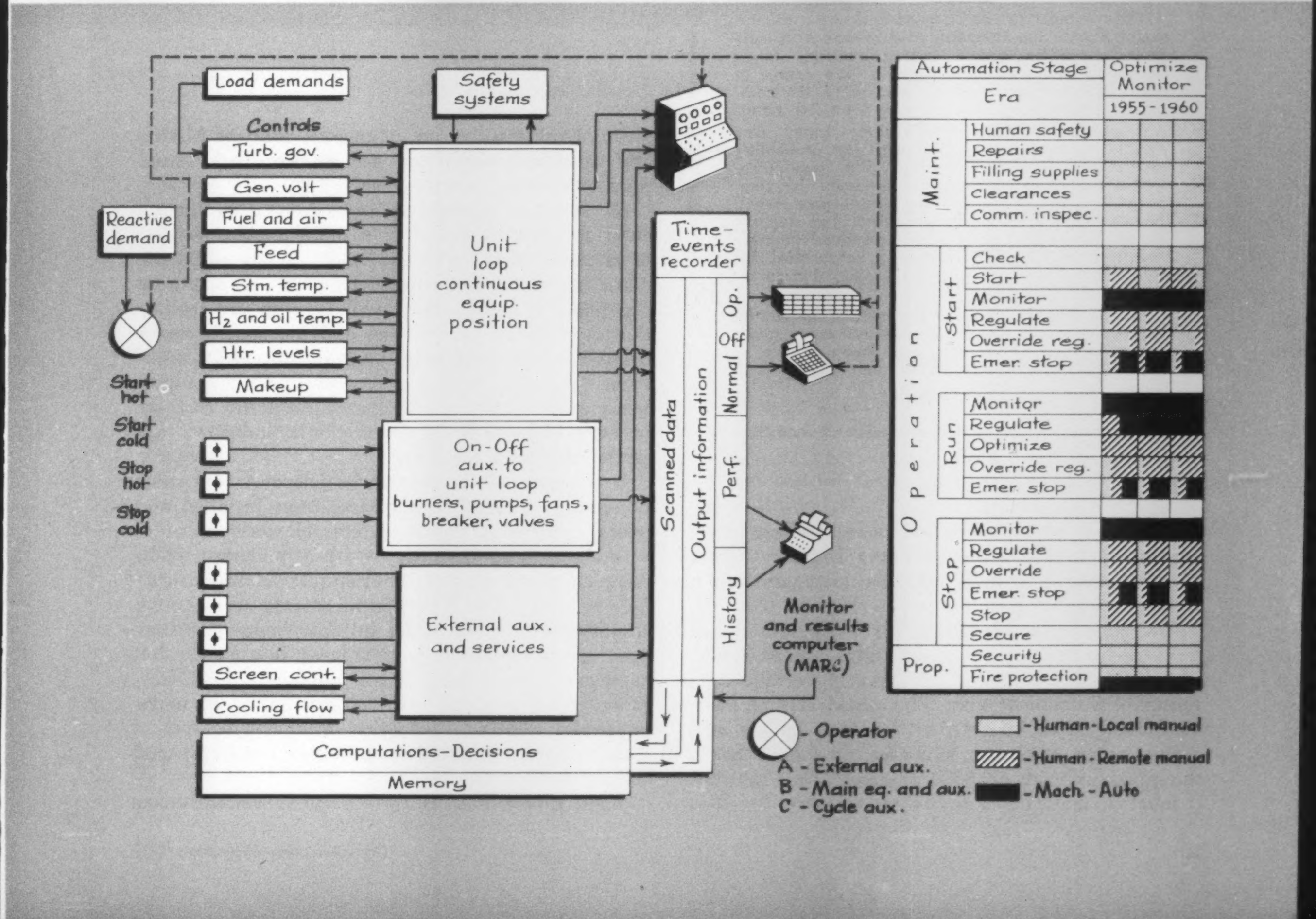
▶ Cost and Value

What is the cost of a computer scanning and logging or MARC type system? What is the cost of an automatic plant? What are the potential worths of these systems?

The MARC and the automatic plant systems are analyzed separately, Table 1, for three reasons: 1. An automatic plant requires a MARC type computer but a MARC system can be installed without achieving automation. 2. There are different degrees of benefits to be achieved from the two systems. 3. Many utilities may wish to obtain experience with a MARC type system before proceeding to an automatic plant.

The prices that will be quoted in the future as competition is increased are not known. The cost figures given in Table 1 must therefore be considered as present-day, general order of magnitude figures that illustrate the approximate investment, requirements for operating manpower, and potential relative thermal economies to be gained with the three types of plants discussed.

Note that for a conventional gas-fired plant with two 200,000-kw class turbine generators a total investment for instrumentation and control of $2 million, or $5.00/kw, is indicated. This includes all conduit and wiring, piping, the control room with its lighting, air conditioning and other features, gage boards, instrument air compressors, motor control, and other elements chargeable to instrumentation and control. This may seem to be a high figure, however, cost accounting records are seldom kept in a manner that segregates into a separate account all of the costs attendant to instrumentation and


Load demands
Safety systems
Controls
Turb. gov.
Gen. volt
Fuel and air
Feed
Stm. temp.
H_2 and oil temp.
Htr. levels
Makeup
Reactive demand
Start hot
Start cold
Stop hot
Stop cold
Unit loop continuous equip. position
On-Off aux. to unit loop burners, pumps, fans, breaker, valves
External aux. and services
Screen cont.
Cooling flow
Computations–Decisions
Memory
Time-events recorder
Scanned data
Output information
Op.
Off
Normal
Perf.
History
Monitor and results computer (MARC)
Automation Stage
Era
Optimize Monitor
1955-1960
Maint.
Human safety
Repairs
Filling supplies
Clearances
Comm. inspec.
Operation
Start
Check
Start
Monitor
Regulate
Override reg.
Emer. stop
Run
Monitor
Regulate
Optimize
Override reg.
Emer. stop
Stop
Monitor
Regulate
Override
Emer. stop
Stop
Secure
Prop.
Security
Fire protection
- Operator
A - External aux.
B - Main eq. and aux.
C - Cycle aux.
- Human-Local manual
- Human-Remote manual
- Mach.-Auto

control. The cost reports for many projects have been analyzed and a cost of about $5.00/kw is not far from correct for a 200,000-kw class unit when all factors are included.

The added cost of MARC for a two-unit plant is in the neighborhood of $200,000, or $0.50/kw, including all credits for omission of certain conventional instrumentation. The added cost of automation over and above MARC cannot be too well defined with certainty. However, it should be in the neighborhood of $600,000/unit, or $3.00/kw. It must be emphasized that these costs are based to a considerable degree on judgment—both the MARC and automation concepts are so new that actual costs cannot be predicted accurately.

As more manufacturers of computer equipment enter the field, the cost of a more modern version of either MARC or its equivalent in an automatic plant may tend to decrease. However, as operating experience is gained, there will be a greater realization of computer system uses and the benefits to be derived from expanded utilization of such equipment. This may lead to successively more comprehensive installations which may keep the cost up, or even increase it. In other words, industry's appetite may well increase.

It is impossible to accurately determine the value of equipment until after it has been installed and operated for some period of time. However, in order to attempt to evaluate the worth of making a plant completely automatic it is essential that some numbers be assigned to the potential savings even though they are assigned with the full knowledge that they are "guesstimates." On this basis it appears that savings can be obtained in the following areas: Manpower; fuel savings; reduced possibility of major equipment damage; reduction in major equipment maintenance; elimination of minor mishaps; and intangible benefits.

Each utility has its own peculiar circumstances

AUTOMATIC PLANT

EXPERIENCE to date with one MARC system, although of limited duration, has resulted in the belief that automation can be accomplished in a reliable and satisfactory manner. The present concept of automation includes:

1. Starting the plant equipment from a cold or hot condition after prescribed initial conditions are set up by the operator or maintenance crew. The automatic system would functionally check initial conditions to assure safe operation. All equipment would be started in normal sequence with each required intermediate condition being satisfied both for the individual piece of equipment and for other affected equipment and for the station as a whole before proceeding to the next step in this starting sequence. This starting sequence would be carried through synchronization and load application up to the desired load.

2. The computer and associated analog controls will operate, start, stop, reposition, or adjust the equipment as necessary to follow system load demands while maintaining optimum efficiency for the uncontrolled conditions existing, i.e., the circulating water temperature, fuel analysis, atmospheric conditions, degree of condenser fouling, etc. This requires efficient modulation of the turbine generator governor to the desired load, boiler fuel and air to desired steam output, boiler steam temperature control system, turbine generator cooling systems, and any other controls that must be adjusted as a function of load.

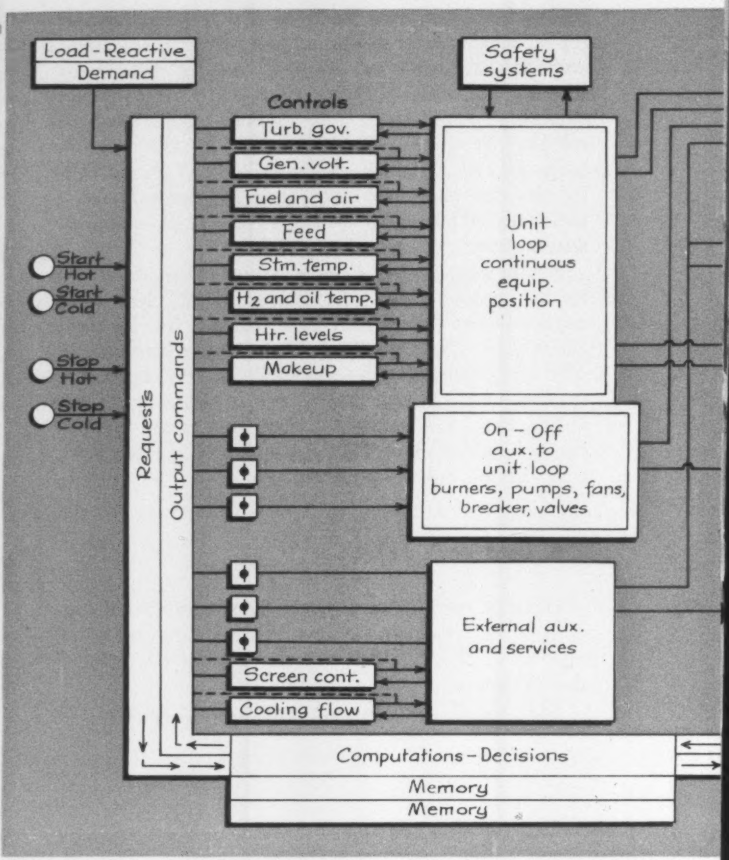
3. The system will shut down the plant, on command, in a safe manner.

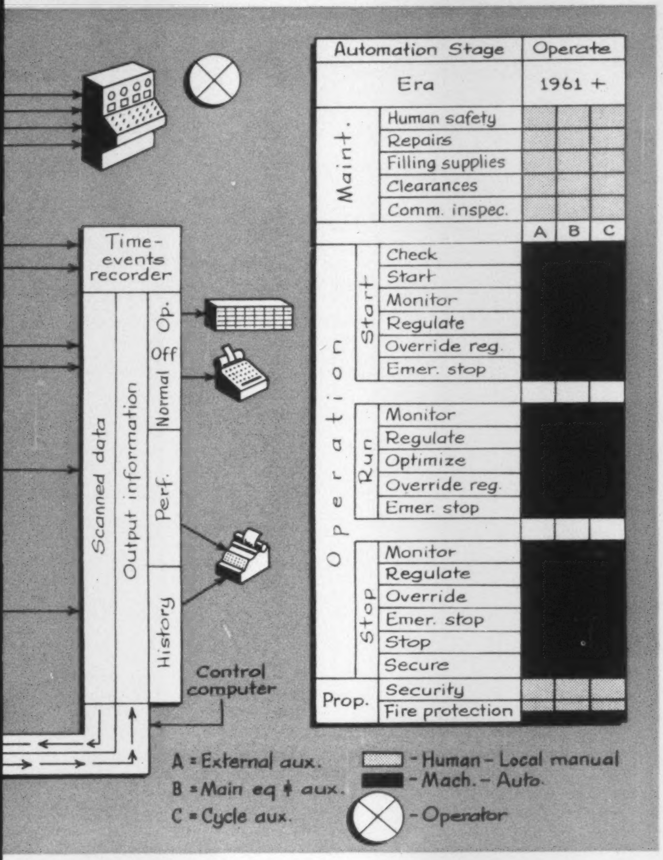
In addition there would be provided all of the features of scanning and logging of plant variables plus results computation included in the MARC system. In an automatic plant the computer not only reports operating results, it controls operations.

The computer can be designed to do what the operator should do, including the initiation of necessary corrective actions during starting, operation, load changing, and stopping. The degree of such corrective action is a function of the computer memory size and availability of needed inputs.

A computer system can do these things more rapidly, more accurately, and with less probability of error than a human operator. Plant equipment would conceivably be treated better by the computer than by an operator since the computer will be starting, operating, changing load, and stopping equipment in accordance with a prepared program requiring that specific conditions be satisfied before proceeding to the next step and during the execution of that step.

Successful adaptation of a computer to control of a plant will require the closest co-operation among utility, consultant, and manufacturers of instruments, computers, turbines, boilers, and auxiliaries.




Automation Stage
Operate
Era
1961 +
Maint.
Human safety
Repairs
Filling supplies
Clearances
Comm. inspec.
A
B
C
Operation
Start
Check
Start
Monitor
Regulate
Override reg.
Emer. stop
Run
Monitor
Regulate
Optimize
Override reg.
Emer. stop
Stop
Monitor
Regulate
Override
Emer. stop
Stop
Secure
Prop.
Security
Fire protection
Time-events recorder
Scanned data
Output information
Op.
Off
Normal
Perf.
History
Control computer
A = External aux.
B = Main eq & aux.
C = Cycle aux.
▨ - Human - Local manual
■ - Mach. - Auto.
- Operator

determining the number of operators employed in its plants. However, for two 200,000-kw class units with good, modern, conventional instrumentation and control it would be possible to operate satisfactorily with six operators per shift including supervision. In addition there would be the normal complement of other personnel including a chemist and an efficiency engineer. With MARC installed, but with conventional controls, one less operator would be required for the auxiliaries since that equipment would be monitored. This reduces the staff to a total of five operators per shift. The chemist would remain but the efficiency engineer would serve as computer engineer since his former calculation functions would be handled by the computer.

For the automatic plant there would be one control supervisor and one control room operator. These personnel would, under normal circumstances, have little to do. They are required in event the computer is taken out of service. There may be the possibility of eliminating the chemist but the value of this is not included in the chart.

With MARC and conventional controls there should be a fuel savings since calculated performance of the station as a whole and of individual major pieces of equipment is reported hourly or on demand while there is still an opportunity for the operating staff to take corrective action. If the potential fuel saving is assumed to be 50 Btu/kwh (0.5 per cent), which appears reasonable, and it is assumed that the operators will take proper corrective action half the time, there would be an annual saving of 25 Btu/kwh. With an automatic plant the computer, not the human operator, takes the corrective action and there would be an assumed average annual savings of 50 Btu/kwh.

The capitalized value of the estimated manpower and fuel savings thus seems to justify MARC in a plant with conventional control, but may not justify the cost of complete automation. Other benefits which are either intangible or extremely difficult to evaluate must be examined.

▶ Other Savings

It is estimated that there is approximately one major accident per 100 units per year or one major accident per every three units during a unit's life. On the average today a major accident for a 200,000-kw class unit would cost about $1 million in damages and from two to four months outage time. Estimating the outage at $8000 per day this would be from $500,000 to $1 million in outage cost or a total cost of $1.5 million to $2 million. The minimization of this risk is valuable.

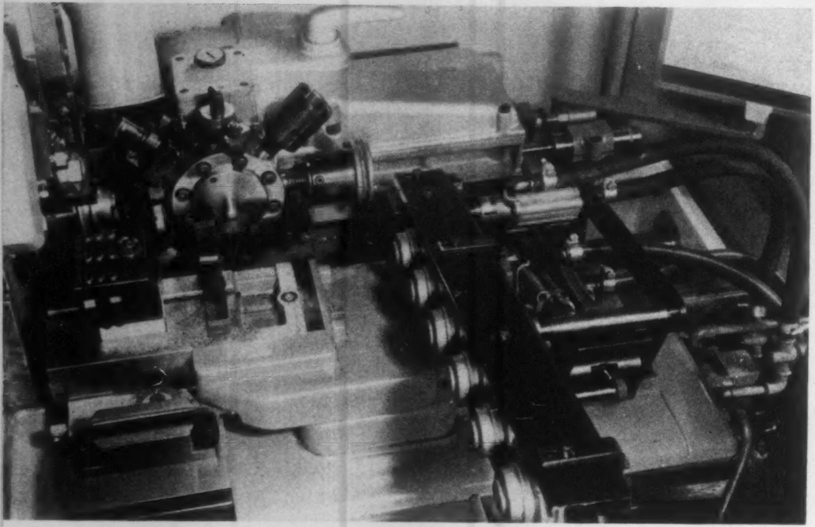
The potential reduction in major equipment maintenance is even more difficult to evaluate, but if it is assumed it would save one day every two years at $8000 a day it would be worth $4000 per year per unit.

Automation could eliminate many minor mishaps arising from forgetfulness, which results in outages, and assuming these amount to approximately one day per year, there could be saved $8000 a day each year.

In addition to these factors there would be the benefits of improved maintenance scheduling and probably reduced maintenance downtime due to an improved ability to troubleshoot with the aid of the records kept on the operation and operating variables. There is also a better chance of operating the plant by substitute personnel during emergencies. Finally, the use of a computer provides experience with an automatic system for future evaluation of plant design and the possibility of further actual investment and operating savings to be obtained through automation.

Such an analysis points up the evolutionary nature of control development. Techniques have progressed from local to central display of readings and from independent operation to co-ordinated combustion control; techniques will now progress to central digesting of information and thence to overall automatically co-ordinated plant control.

New central stations need and can justify MARC —and such stations will soon require automation. In the meantime, depending on individual circumstances, automation may or may not be justified on the basis of conventional economies (i.e. possible reduction in labor and fuel costs) but the additional benefits have a potential monetary value that may well justify such installations.

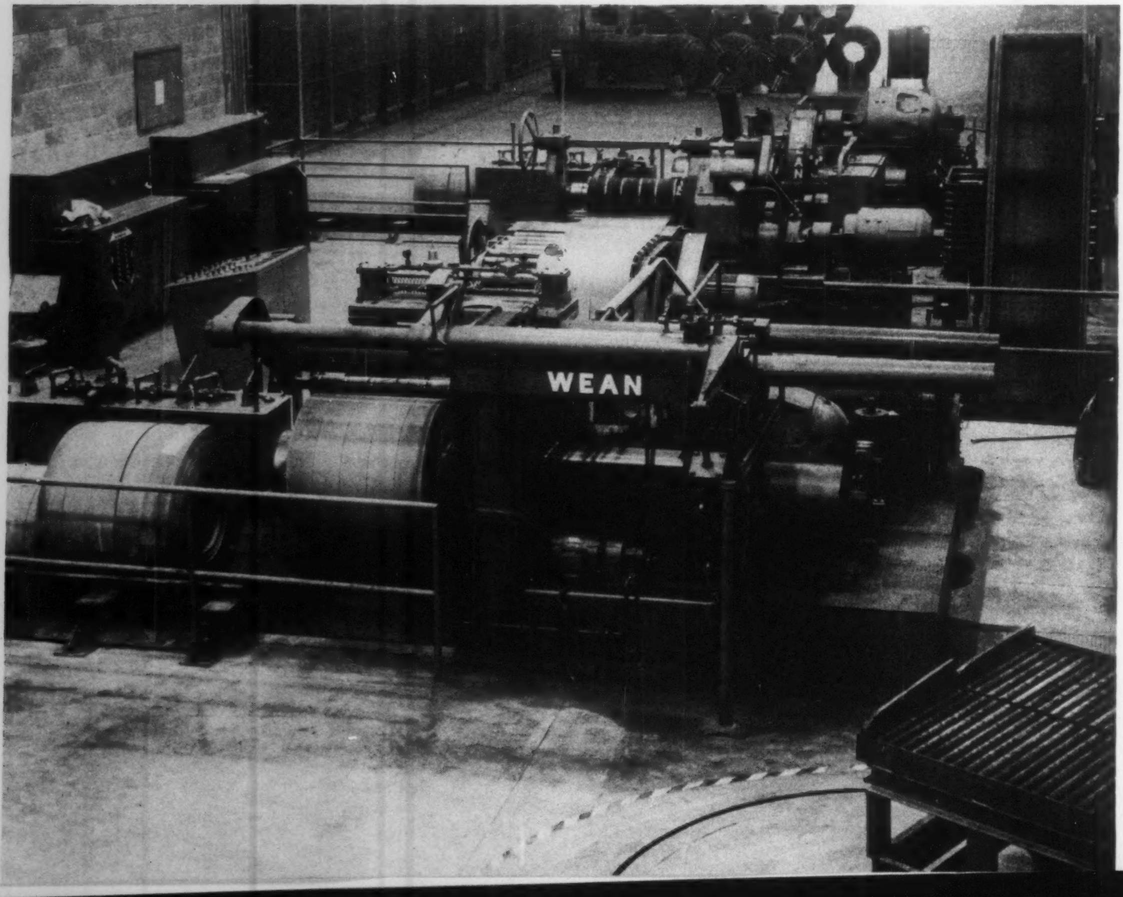


Improved Machining

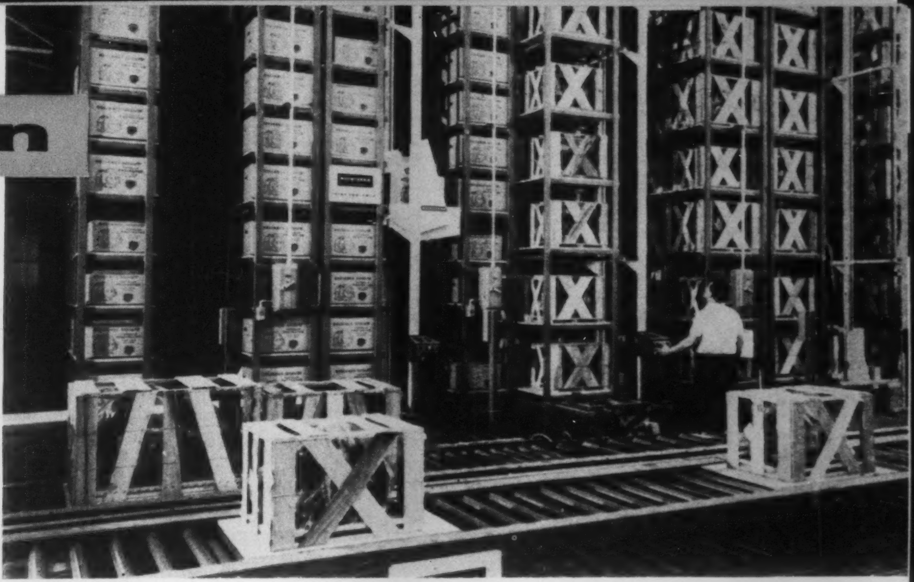
AUTOMATIC machining operations on 3-inch diameter pulley of alloy cast iron have been speeded up enough to triple output by changing the grade of carbide tools used. Located at Geneva, Switzerland, plant of Tarex Ltd., the single-spindle Tarex automatic performs 24 machining operations on the pulley; turning speeds now obtainable range from 610 to 820 sfm and boring speeds from 180 to 430 sfm resulting in a total machining time of 61 seconds as compared to previous 180 seconds per piece. Illustration shows magazine feeding arrangement containing six pulley blanks. Blanks are transferred to collet station on turret and subsequently to spindle. Turret also contains an unload collet and six tooling stations. Brazed tips for revised tooling setup are made by Kennametal Inc.

Slitting to Size

WITH building of new transformer manufacturing facility at Athens, Ga., Westinghouse Electric Corp. established a large-scale installation for mass production of new type of distribution transformer core. The new core is basically a continuously wound and shaped loop of specially treated Hipersil strip steel. For maximum economy in production of various size cores, the strip is purchased in large coils and then slit to desired width dimensions. Slit coils are then further processed in a rewinding and shaping operation. Shown is initial strip processing line where large coils are slit into a number of smaller coils. Supplied by Wean Equipment Corp., this line consists of an uncoiler, slitter, tension stand, and recoiler. Features of the line include integrated material and scrap handling, and console controls for one-man setup and operation.

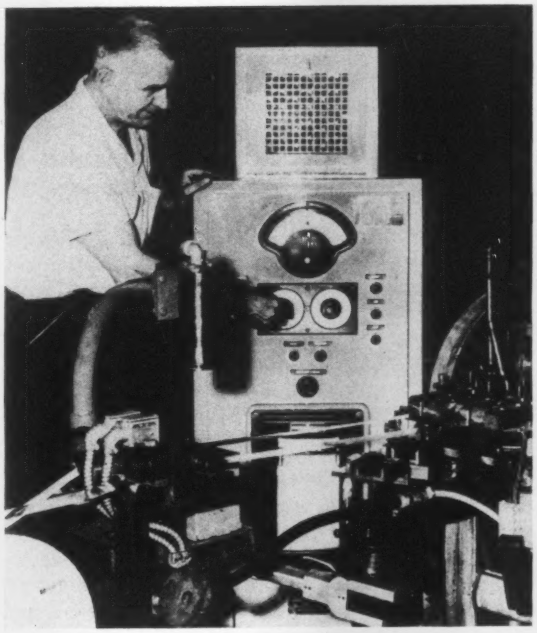


in action



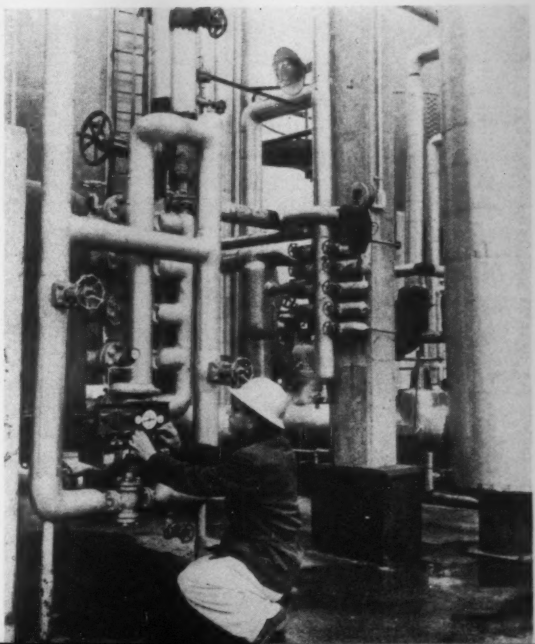
Automatic Storage

SINGLE operator handles storage facility containing 4800 compartments (each of 3500-pound capacity) at end of motor production line. With aisles as narrow as 30 inches and up to 150 feet in length, storage system supplied by Triax Equipment occupies only 5005 square feet of floor space. As shown, larger motors are stacked 8 high; smaller motors are stacked 12 high. Operator positions motor before desired aisle; the load is then automatically transferred to a load position. Desired compartment, on either side of aisle, is selected at punch-key panel and a traveling carrier moves horizontally along aisle and then vertically at a given point to deposit the motor in the compartment. Items are automatically retrieved by directing the empty carrier in a similar manner to a filled compartment.



Portable Gage

IN manufacture of radiator tubes from brass strip and cooling fins from copper strip, Blackstone Corp. has improved production by use of portable x-ray gage equipped with chart recorder. The unit is used to gage representative coils from shipments when they first reach the production floor. The continuous strip recorder on the gage provides the detail record of inspection which goes back to the supplier along with defective material. The portable gage is also used as a trouble shooting aid to check the gage of strip when difficulties are being experienced on forming presses. Supplied by Industrial Gauges Dept., Daystrom Inc., the x-ray gage in this installation checks the thickness of 0.0025-inch copper strip to determine if it is within tolerance limits of plus or minus 10 per cent of nominal gage.



Localized Control

AT six field locations in a Cities Service asphalt refinery, valve-mounted pressure and temperature instruments provide localized proportional control. Supplied by U. S. Gauge, Div. of American Machine and Metals Inc., the units supplement an extensive instrumentation system by maintaining secondary variables at desired values in such applications as regulating steam pressures to feedwater deaerating heaters, steam pressure reduction, and pressure control for a fuel oil recirculating pump. The pictured temperature controller mounted on the yoke of a pneumatically operated diaphragm valve regulates temperature of steam-heated fuel oil.

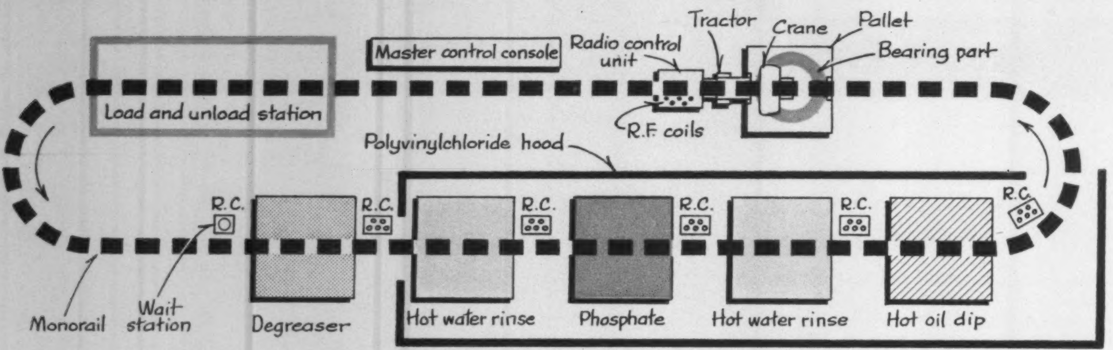


Fig. 1—Large bearing parts are placed onto processing pallets in the loading area. An operator then manually controls the crane unit as it lifts the load and moves the pallet to the wait station. From this point, the part is cycled automatically through five treatment baths and returned to the unload area. During the automatic cycle period, the crane unit is controlled by radio frequency control boxes (marked R.C.) which receive actuating impulses from the master control console.

RADIO CONTROLLED PHOSPHATING LINE

HANDLES LARGE PARTS

Don't overlook automation when your problem concerns the handling of extremely large parts in a processing line. In this automatically controlled phosphating line, mill roll bearing parts weighing several tons each are handled efficiently, economically, and safely by means of radio controlled crane units.

By **S. A. CHOJNOWSKI** and **H. P. WHITTAKER JR.**, Project Engineers, Timken Roller Bearing Co., Canton, Ohio

WHEN planning automated production lines, there often is a tendency to decrease the degree of automation applied as the size and weight of the parts grow larger and larger. However, in many cases automation is the only means by which a part can be processed efficiently, economically, and safely. A case in point is the handling of large mill roll bearings in a finishing operation at Timken Roller Bearing Co., Canton, Ohio.

Large mill roll bearings are manufactured in diameters up to 6 feet and weigh up to several tons each. While many of the bearings are used in new installations within a few weeks after manufacture, many other bearings are used domestically and overseas as replacement parts, requiring storage at the user's plant of a few weeks to years. During the storage periods, the bearings must be protected from corrosion. For many years Timken has been phosphating its smaller tapered roller bearings to prevent corrosion, but their equipment was not large enough to handle the huge mill roll bearings. Therefore, the large bearings were carefully lubricated and packed in the best available materials for shipment, and, when received by the customer, were unpacked and submerged in an oil bath until needed. This procedure was very costly and dangerous for the user, considering the size and weight of the bearings.

To eliminate the user's storage problem and to extend the shelf life of the large bearings in their original packages, Timken decided to set up facilities for phosphating the mill roll bearings. Since the existing phosphating facilities for the smaller bearings could not be revamped or economically expanded to handle the large product, a new phosphat-

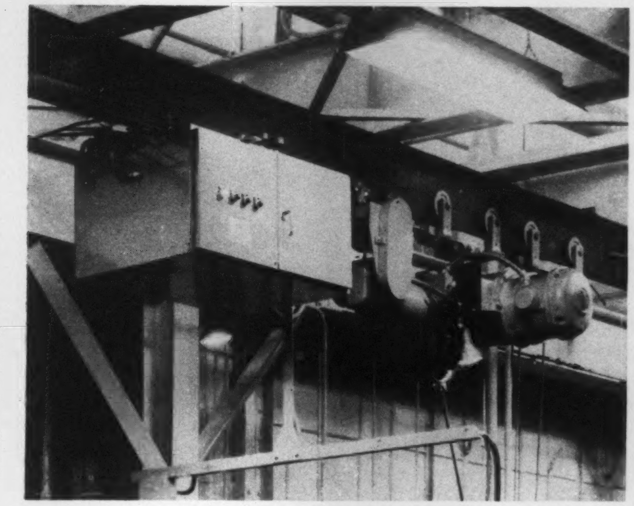
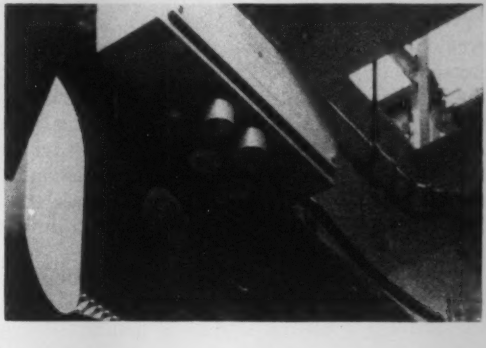


Fig. 2—Two 5-ton overhead crane units are used in the phosphating system. Each articulated crane unit consists of a leading radio frequency control section, a tractor, and a trailing hoist holding the load. On top of the control section are five coils which transmit signals to stationary control boxes (see inset) at each processing station. When the sending and receiving units are aligned at each station, there is an air gap of about 2 inches between the coils.



ing facility was engineered which was capable of handling both large and small products.

Handling System

A plan view of the new phosphating line is shown in *Fig.* 1. Five processing tanks are installed in a large concrete pit. The tops of the tanks project about 3½ feet above the floor level, and each tank has a capacity of 3400 gallons of liquid. The first tank in the line is a vapor degreaser, and this is followed by a hot water rinse, a phosphating dip, a second hot water rinse, and a hot soluble oil dip.

Parts are cycled through the process baths by means of two 5-ton overhead cranes mounted on a closed loop monorail, designed and installed by the Spanmaster Crane Div., Jervis B. Webb Co. This handling system is unique in that the crane movements are controlled by radio frequency signals in accordance with a program set up in a central control unit. As shown in *Fig.* 1, stationary control boxes that can receive and transmit radio frequency signals are located at six points on the monorail system. These control boxes act as an intermediary between the radio control sections attached to the cranes, *Fig.* 2, and the master control console. Coaxial cables are used to link the stationary control boxes to the master control.

When the crane radio control unit is directly beneath a stationary control box, five radio frequency coils on top of the mobile unit are within two inches of five other coils on the stationary unit. Signals originated by the master control cause the traverse or tractor motor to stop, halting the crane over the solution tank. Then other radio frequency signals cause the crane lift motor to lower and raise the load pallet into and out of the process solution. After processing is completed at the tank, the tractor motor is started again to move the part to the next station.

System Operation

The largest size bearing that can be phosphated in the system is one that is 72 inches in diameter

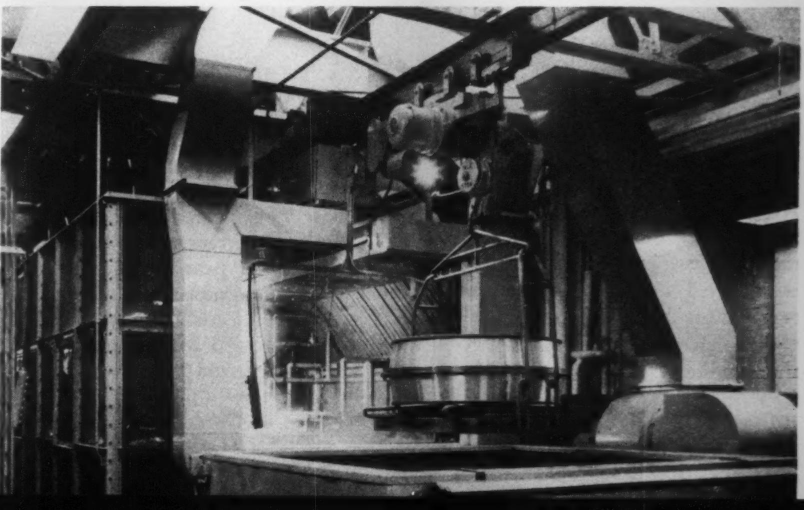


Fig. 3—A double cone weighing 1850 pounds is poised over the degreaser tank. The cone is 57 inches in diameter and 24 inches high. In the background can be seen the polyvinylchloride hood surrounding the remaining processing tanks. The radio control unit for the hoist is aligned directly below the stationary control box for this station.

and 60 inches high. After disassembly, various parts of the bearing are placed on processing pallets at a loading station. Using manual control units attached to the crane, an operator lifts the pallet and moves it to a wait station from which point the crane unit is automatically controlled from the master control console. When the preceding crane unit has cleared the first three tanks, the master control transmits a radio frequency signal to the waiting crane unit and causes it to move forward slowly to the first processing station, a vapor degreaser, *Fig.* 3.

When the pallet is centered directly over the degreaser tank, the tractor motor stops. After a 21-second pause which allows the pendulous motion of the load to subside, the bearing part is lowered into the degreaser tank for a 10-minute dwell period. At the end of this time, the control panel signals the crane to lift the load, requiring 25 seconds, and to hold the load in a raised position over the tank for 18-seconds delay to allow solution to drain from the part and pallet.

The crane unit then automatically indexes to the next solution tank, a hot water rinse, and repeats the dipping cycle in a similar manner except for different dwell and delay time periods. The third tank contains the phosphate solution where the part is submerged for 20 minutes. When the crane unit lifts the parts from this tank and moves to the next solution, the master control console signals the wait station to release the next crane unit into the process. A 1-minute hot water rinse follows the phosphating operation, and the last tank is a hot soluble oil rinse to provide inplant rust prevention.

Having completed the bath cycle, the tractor motor moves the crane to an unloading platform where the motor is stopped automatically. The unit is then manually operated for unloading of the phosphated part and the loading of a new part.

▶ Design Features

Although only two crane units are used in the system at the present time, additional units can be added if required. To prevent a moving crane unit from ramming a stationary unit, contact switches are mounted on both ends of the units. When these switches are actuated, power to the tractor motors is cut off. Trouble occurring during the bath cycles is indicated by an alarm bell ringing at the master control panel, and the trouble point is pinpointed by a light on the panel.

A special revolving drum attachment, *Fig.* 4, permits the phosphating facility to be used for small bearing parts. Each crane unit is equipped with a retractable power line having water tight connectors. When the drum attachment is used, the connector is plugged into a motor mounted above the drum. During manual operation of the crane unit, the drum motor is de-energized. However, when the crane unit is switched to automatic control, the drum motor revolves the drum at 4 rpm.

Since phosphate fumes are corrosive and poisonous, the handling of contaminated air over the processing tanks was given prime design consideration. The trichlorethylene fumes from the degreaser tank are withdrawn through a shroud around the top of the tank and are vented to atmosphere outside the plant. The other four tanks in the line are surrounded by a polyvinylchloride hood which has air seals maintained across the entrance and exit openings and the slot along the top through which the crane hook rides. An air circulating system is mounted directly above the hood. Air exhausted from the hood is cleaned, washed, and neutralized of any acid by two air washers capable of handling 12,500 cfm each, and a third 8000 cfm unit. The two larger units recirculate cleaned air into the hood through the air seals, and the small unit exhausts air to atmosphere. Sufficient fresh makeup air is added to the system to maintain a positive pressure in the hood.

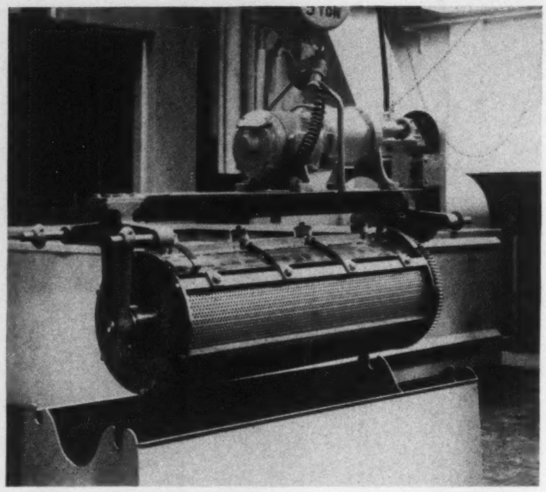
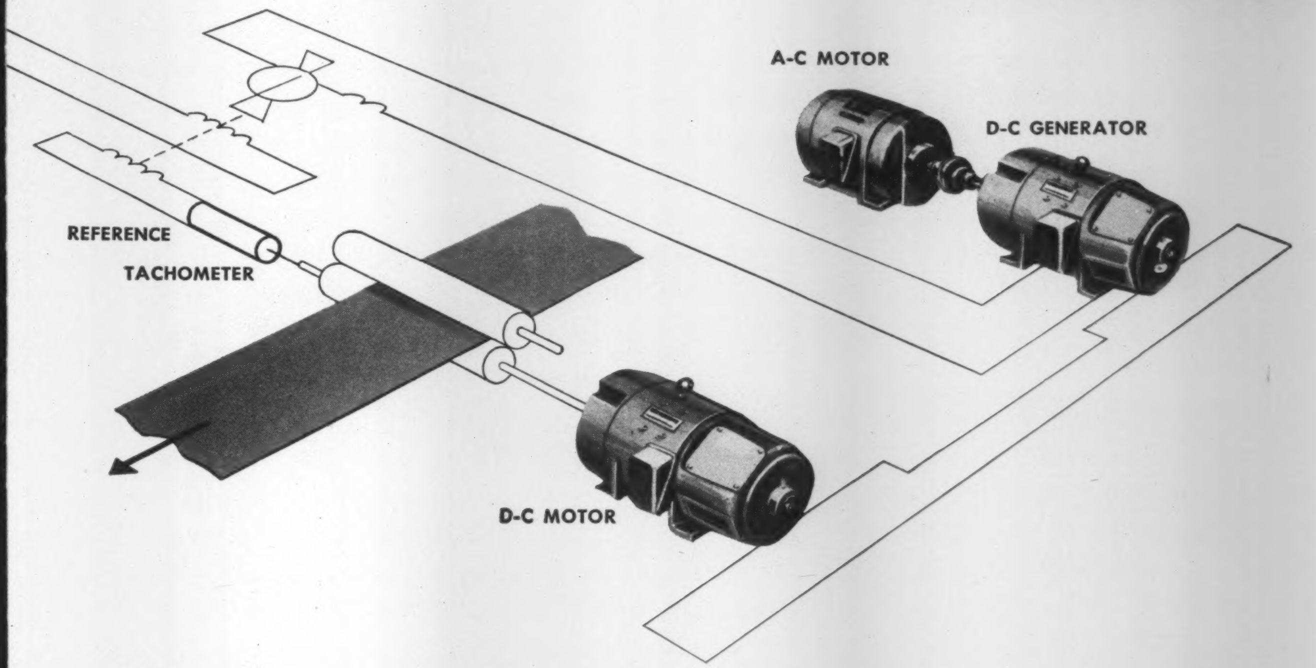


Fig. 4—Revolving drum attachment allows the phosphating system to be used for processing small bearing parts. Several thousand rollers can be phosphated at one time in this unit. When not in use, the drum attachment is stored on the portable stand which can be moved away from the line.

▶ System Payoff

The total investment in equipment and installation for the phosphating line facilities was $187,300. In the first year of operation, the line earned $191,545 in direct equipment and manhour savings—paying off the total investment in less than a year and producing a saving of over $4000. In addition to making possible the phosphating of extremely large parts (which could not be handled previously), the automated line provides savings in processing small bearings. On small product alone Timken is now processing as much work in 1½ shifts as was previously handled in 3 shifts. This decrease in production time has allowed the company to process many parts that were not phosphated previously.

D-C DRIVES FOR PRECISE CONTROL



Problem: How to obtain precise control of machine speeds without human direction

Automation's most important requirement—*self-control*—enables machines to process work continuously with minimum human effort. This is why the trend to continuous automatic processing is a trend to direct-current drives. ***For d-c can best supply the precise regulation and self-control that enables a machine to correct its own errors without human direction.***

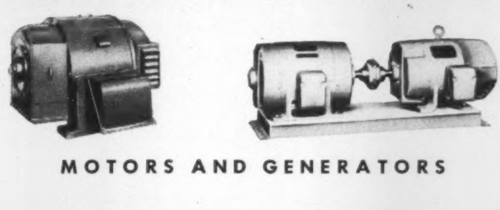
Feedback—the heart of automation—compares machine output with pre-established standards. Deviations are corrected automatically, instantaneously. This is just one example of d-c's modern capabilities.

If you are seeking more automatic, lower cost means of production, it will pay you to investigate direct-current drives. A new booklet, "WHY D-C?", written for modern industry's management team, is available to help you. For your free copy, write *Section 829-4, General Electric Company, Schenectady 5, New York.*

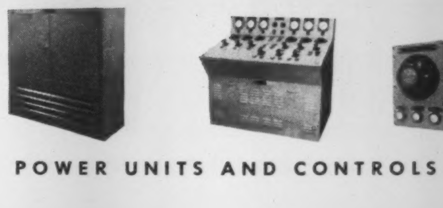
Progress Is Our Most Important Product

GENERAL ELECTRIC

SELECT FROM GENERAL ELECTRIC'S COMPLETE LINE OF D-C DRIVES

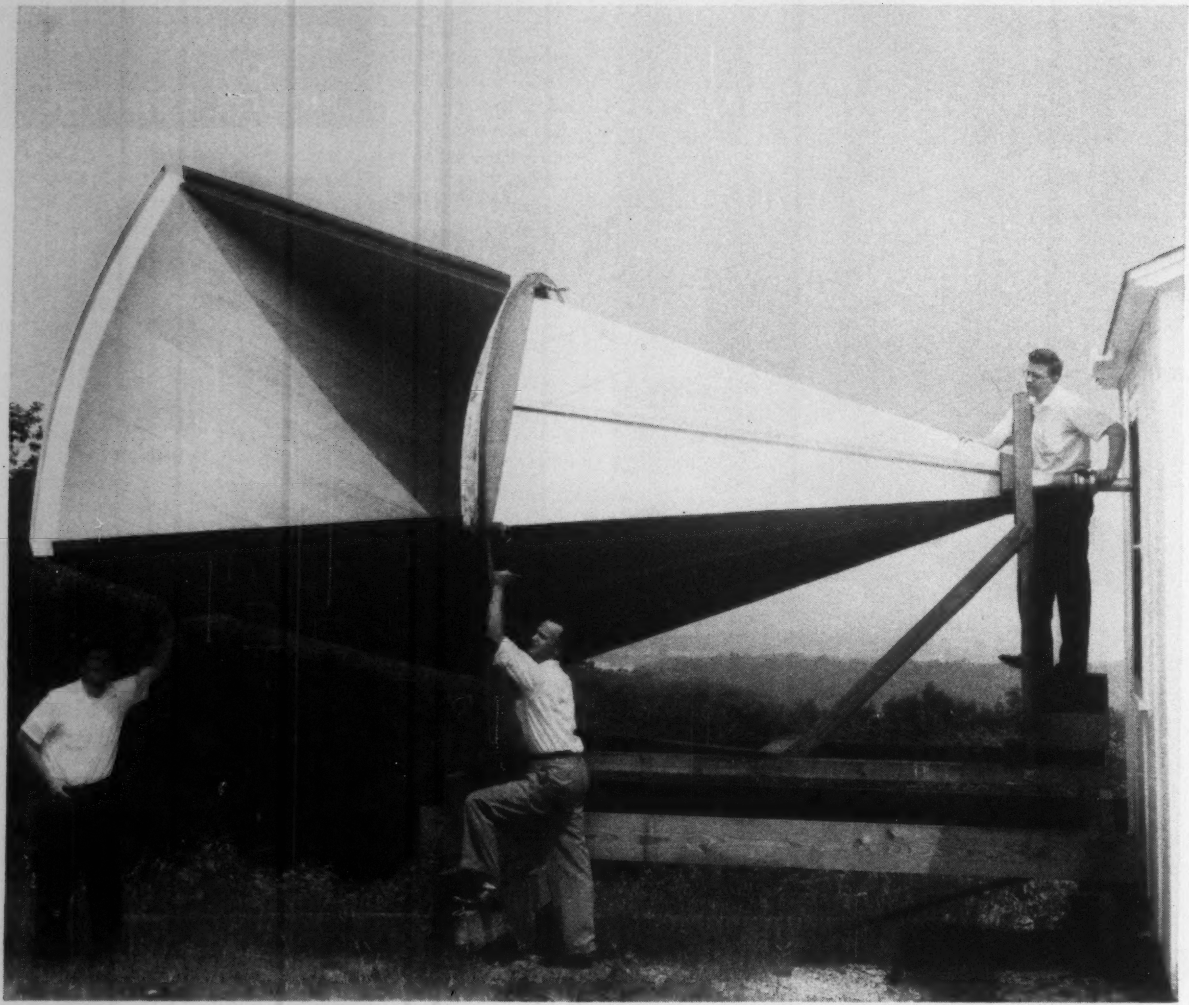


MOTORS AND GENERATORS



POWER UNITS AND CONTROLS

Circle 690 on Page 19



At Bell Laboratories, Holmdel, N. J., a horn reflector antenna is beamed skyward by scientists Edward Ohm, David Hogg and Robert DeGrasse. The maser amplifier, which employs a ruby cooled in liquid helium, is inside building at right. Over-all "noise" temperature of antenna, amplifier and sky is only 18°K at 5600 megacycles.

ANOTHER STEP TOWARD SPACE COMMUNICATIONS

The above antenna is part of a new ultra-sensitive radio receiving system under development at Bell Telephone Laboratories. It has extraordinary directivity. Beamed skyward, it ignores radio "noise" from the earth, yet picks up extremely weak signals from outer space.

The signals are amplified by the latest Bell Laboratories "maser" amplifier. The maser principle was first demonstrated, using gas, by Prof. C. H. Townes and his collaborators at Columbia University. Bell Laboratories scientists applied it to the solid state guided by a theoretical proposal of Prof. N. Bloembergen of Harvard University. Their latest traveling wave maser amplifier employs a ruby mounted in a waveguide. The ruby is excited to store energy. As signals pass through, they absorb this energy and are thus amplified. The device uniquely combines the characteristics needed for practical space communication: extremely low inherent noise and the ability to amplify a broad frequency band.

At present the receiving system is being used to pick up and measure minute radio noise generated by the atmosphere. It also foreshadows important advances in long distance communications. For example, it could extend the range of space-probe telemetering systems, could help make possible the transatlantic transmission of telephone and TV signals by bouncing them off balloon satellites—and has numerous applications in radio astronomy and radar.

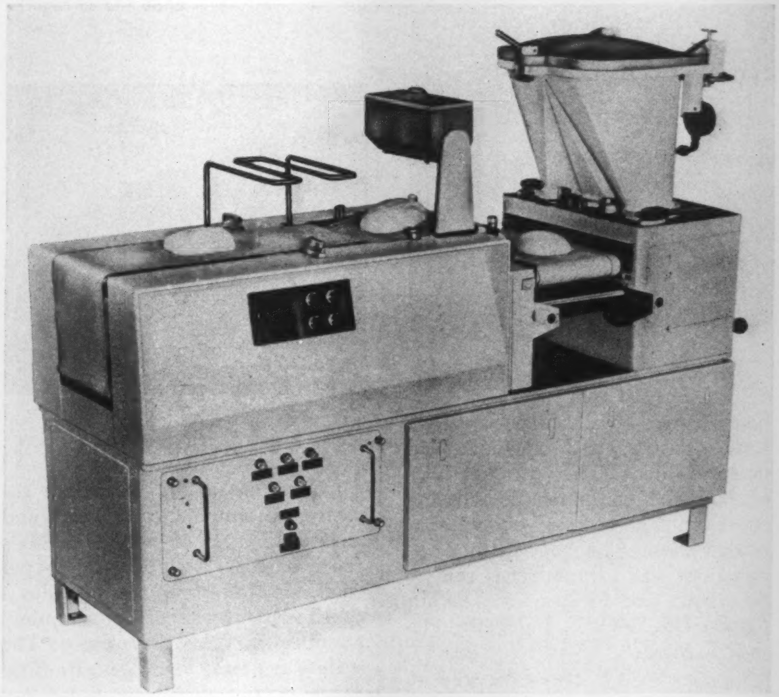
This pioneer development in radio reception is one more example of the role Bell Laboratories plays in the pursuit of better communications technology.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

AUTOMATION new equipment

Machines and plant equipment for more automatic operations.
For detailed information and literature, use card Page 19.

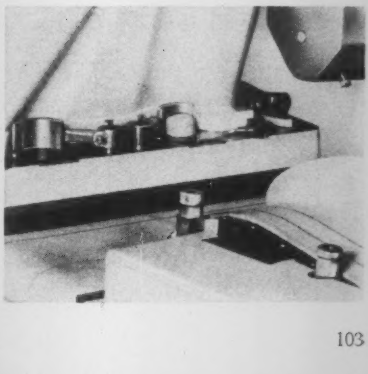


Bread dough pieces from divider are weighed under formed wire element, passed to transverse conveyor belt, and receive incremental pieces if required. Pieces having correct weight are passed to rounder, and overweight and grossly underweight pieces are ejected, by action of reversible belt. Unit handles 160 pieces per minute.

Dough Weight Controller Corrects By Increments

AN ANSWER to the problem of overscaling in the wholesale bakery industry is a bread weight controller developed by **Packaging Machinery Div., Food Machinery & Chemical Corp.**, 4900 Summerdale Ave., Philadelphia 24, Pa. The machine provides accurate weighing of every dough piece, automatic control of divider output, and automatic correction of underweight dough pieces. It operates at speeds of up to 160 loaves per minute. Adjustments to the separate dough divider are based on the weight of every dough piece. Individual weight signals for each dough piece are received by an electronic control system where they are classified and flashed ahead to an increment adder which performs one of five functions. The functions include: Passing all correct-weight pieces; adding one small dough increment for pieces slightly underweight; adding a large increment for pieces that are more underweight; adding two increments to pieces that are badly underweight; and rejecting dough pieces that are grossly underweight or are overweight.

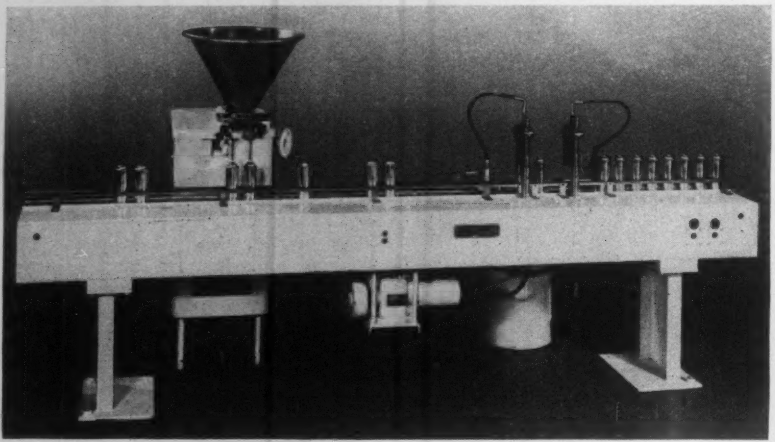
In operation, increments of each size are formed from material in a pressurized hopper by an intermittently rotating forming disc. Each disc contains six circular openings, or forming pockets. A piston associated with each disc ejects formed increments to a flipper. The divider control is automatically adjusted by a feedback signal from the weigher control system so that most dough pieces will leave the divider in an underweight condition, to be corrected by the increment adder. Each dough piece is delivered from the divider to the weighing mechanism by the conveyor. Weights of dough pieces are received by the electronic system, classified, and flashed ahead to the increment adder for correction of individual pieces. The system also assembles, averages, and feeds back the weight



Dough increments are formed in two sizes and fed to flippers shown. Underweight dough pieces may receive one small, one large, or both increments to bring them up to weight.

information so the divider output can be adjusted automatically. At the dough increment adder, the proper amount of dough is added according to the information received from the electronic weighing system. A weight record can be automatically made on tape with optional equipment showing the weight of each piece of dough handled by the machine.

Circle 401 on Page 19

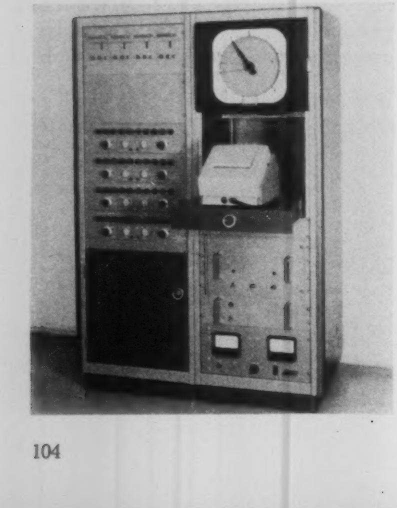


Aerosol Filling Line

Designed for medium-volume automatic production, aerosol filling line is capable of handling up to 30 containers per minute on a single straight line. It is designed for filling the containers with liquids and light viscous materials. A twin line with similar equipment will pressure-fill up to 60 containers per minute. Equipment in the line includes a variable speed drive; a double-ported, two nozzle filler; a single head crimper; and a single-head pressure-filler. The pressure-filler enables the container pressurizing operation to be carried out without refrigeration. Changeover from one container size to another is said to be simple and inexpensive. **Arthur Colton Co.,** 3400 E. Lafayette, Detroit 7, Mich.

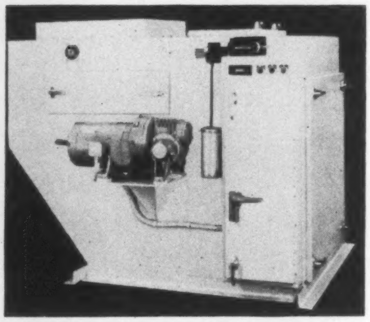
Circle 402 on Page 19

Strain Gage Building Block System



Strain gage digital data recording system is composed of "building block" components such as: Input scanners, shaft position encoder, strain gage control chassis, power supply, self-balancing potentiometer, and data printer. System gives immediate stress data in psi figures. Basic unit can provide for selection of up to 40 strain gages and is expansible in modules of 10 points up to a capacity of 100 points. In operation, the input scanners sequentially select strain gage transducers and present the data to the potentiometer for measurement. The potentiometer positions an encoder to a shaft position corresponding to the magnitude of the input vari- the dough increment adder, the and translated to decimal code by the control chassis which includes facilities for recording two decimal digits of point identification, sign, and three decimal digits of encoder data via the data printer. The printer records the magnitude and point identification of each variable in columnar order on paper tape. **Datex Corp.,** 1307 S. Myrtle Ave., Monrovia, Calif.

Circle 403 on Page 19



Belt Fed Scale

Device has a 200 lb hopper capacity, can automatically weigh and record 15 tph of bulk materials (such as coal) weighing 50 lb per cu ft. It simultaneously provides a continuous record of consumption, accurate to 0.25 per cent. The scale can be set to by-pass the feed chute or to resume automatic operation. Unit has stainless steel feed chutes, skirt plates, regulating plate and hopper to prevent corrosion.

The feeder unit is completely isolated. In the event of a power failure, the material can be by-passed instantly from the feed chute to a gravity discharge opening, without moving or breaking the belt feeder. While engaged in this operation, the feeder can be removed from the enclosure for inspection or repair without spilling by-passed material over the weigh hopper or dump doors. Scale is also available with larger size hoppers and with features such as magnetic head pulleys for tramp iron separation; and right or left hand assemblies. **Beaumont Birch Co.,** 1505 Race St., Philadelphia 2, Pa.

Circle 404 on Page 19

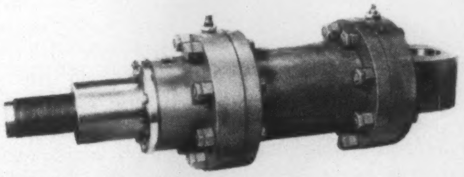
FOR MISSILES . . . OR FOR YOUR POWER CYLINDER APPLICATIONS . . . ANKER-HOLTH RELIABILITY MEANS OPTIMUM PERFORMANCE

Reliability of all missile components is of critical importance. This is one reason why Anker-Holth has furnished the power cylinders in BOMARC installations throughout the country to activate the launcher shelters, sliding them away in seconds prior to firing. Reliability in the products you make is important, too; in the superior performance, lowered operating costs and increased market acceptance. Specify Anker-Holth power cylinders for all of your pneumatic and hydraulic applications. Send for illustrated catalog today.

ANKER HOLTH

DIVISION, THE McDOWELL-WELLMAN COMPANIES

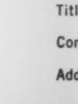
Circle 691 on Page 19



Heavy duty mill type cylinder

Square head type hydraulic cylinder

JIC Standard and Special Cylinders For Every Application



A5

ANKER-HOLTH DIVISION
THE WELLMAN ENGINEERING CO.
2723 Connor St., Port Huron, Michigan, USA

☐ Please send me your complete catalog.

☐ Please send me information for the following application ____________

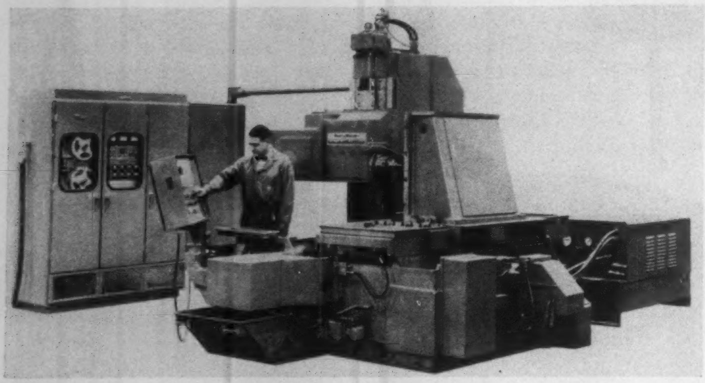
____

Name ____________

Title ____________

Company ____________

Address ____________



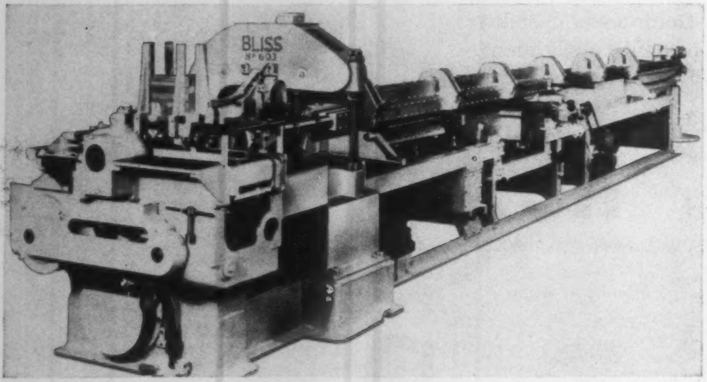
Tape-Controlled Milling Machine

Numerically - controlled machine can automatically mill regular and irregular shapes in three dimensions. There are 18 spindle speeds ranging from 40 to 3600 rpm. Punched tape controls the horizontal and transverse movements of the table on which the work is mounted, the vertical movement of the cutter spindle, and the feed rates. Both automatic roughing and finishing cycles can be coded into the tape to provide for final skin cuts. Symmetrical right and left-hand parts can be cut with the same tape.

If any error occurs or a malfunction is detected, automatic error detecting circuits and continuous digital feedback controls automatically shut down the machine. Jogging controls allow the operator to stop the machine, withdraw the cutter spindle, change the tool, return to machining position and continue under tape control without loss of synchronization. Machine uses Bendix tape control system.

Preparation of a tape for machine operation requires that a line drawing of the part be translated into a numerical drawing. The process planner uses this to set up a process sheet. All pertinent data are shown on this sheet. A paper tape is then punched from the process sheet data and verified. It is then fed to a digital computer which makes the required calculations and perforates the machine-control tape. **Pratt & Whitney Co. Inc.**, West Hartford 1, Conn.

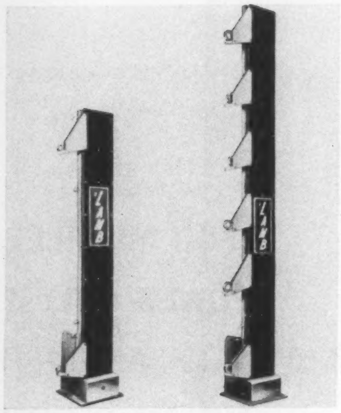
Circle 405 on Page 19



Can Body Forming Machine

Cans up to 6 3/16 inches in diameter and up to 7 13/16 inches in height can be produced on Model 603. It will handle the different sizes with only a modification in the feed bar stroke and replacement of standard change parts in the work station housing. Machine uses an open-arch construction, with one side open to provide access to the forming parts. A centrally located crankshaft provides precise synchronization of all motions. The body feed is the bottom feeding type with a blank hopper and sucker cup assembly. An independently driven two-roll flexer is standard. Protective devices to prevent jamming damage are included. **Container Div., E. W. Bliss Co.**, Canton, Ohio.

Circle 406 on Page 19



Parts Handlers

Applicable for gravity-flow handling systems, single lift elevator and multitrack elevator-distributor units can handle up to 5000 parts per hour. Capacities are doubled for available dual models. Distributors can supply from 2 to 10 lines. The lift mechanism uses a cotter-pin type roller chain with extended pins and nylon part-lift rollers. Pins and rollers can be added or removed, depending on production needs.

In operation, rolling or sliding parts are chute fed to the input terminal located near the base of the elevator. The parts are picked up and elevated to the required height, then cammed out the discharge terminals. Input and discharge heights are adjustable in 6-inch increments. Parts are individually elevated. Units are driven by fractional-hp motors and speed reducer assemblies. In the event that over or undersize parts cause a jam, a pulsating clutch action will clear the jam, then the clutch automatically resets itself. **F. Jos. Lamb Co.**, 5663 E. Nine Mile Rd., Detroit 34, Mich.

Circle 407 on Page 19

Man's eternal Struggle with the Machine

COMPETITIVE PRESSURES AND RISING COSTS DEMAND GREATER PRODUCTION EFFICIENCY THAN EVER BEFORE

How do you know you're making your product right?

Rather curious question, isn't it! But before you laugh it off, take a good look at what's happening on your production line. There's more processes using manufacturers than there are manufacturers using processes.

What you're looking for is efficiency. Lack of it costs money. The kind *you* pay in overhead, competitive advantage, rejects, rework operations, etc.

For example—consider your resistance welding . . .

How many spot welds are you using to assemble the piece parts of your product? . . . as many as will fit in the space? . . . enough to "be sure" it will hold? . . . or as many as *really required!* No matter how you figure it, the first two cost too much money. Because they require either too much equipment or too much time. Usually both!

Many manufacturers use resistance welding for speed. Weld integrity (which, incidentally, does not necessarily penalize speed) is often overlooked. In order to make up for lack of weld quality, more welds are used. But fifty poor welds aren't any better than fifteen poor welds. They just cost more. Particularly when five *welds of suitable quality* will do the job!

Sciaky knows that weld efficiency is a matter of combining quality with speed. That's why Sciaky equipment is precise enough to produce consistently. Once suitable quality is established, you can depend on it throughout the toughest production conditions.

Why take less than the full advantage of consulting with a Sciaky Application Engineer the next time you're considering equipment. No obligation, of course.

The manufacturers of automobile wheels took that advantage. As a result those wheels are now being assembled with eight suitable quality welds instead of twelve rivets. Automatically. Four other operations have even been included. As a result, the wheels are better, and made faster at lower cost.

SCIAKY®

74A

SCIAKY BROS., INC., 4942 W. 67th STREET, CHICAGO 38, ILLINOIS • POrtsmouth 7-5600

O-M
CYLINDER WINS
CONQUEST OF
SPACE IN ORIGINAL
EQUIPMENT!

SERIES 101A

AIR 150 PSI
HYDRAULIC UP TO 1500 PSI
MEETS JIC STANDARDS

By fitting into one-third less space than a tie-rod cylinder of the same bore, this original O-M space-saving component gives greater flexibility to design, reduces weight and cuts installation time.

But there are many other reasons for using this O-M Round-line Cylinder that delivers smooth, dependable power. It has the lowest coefficient of friction . . . assures full-power starts . . . is sealed right—ports are easily oriented independently to 360 degrees . . . and, end plugs are tapped for universal mounting. Easily modified for special applications at a nominal extra over standard cylinder prices. Internal locking key makes it easy to disassemble, service and reassemble with no alignment problems.

Available for Air or Hydraulic circuits in a complete range of sizes (1½" to 8" bores) with standard, 2 to 1 or oversize rods. All-steel construction with bearing bronze. Completely interchangeable parts. Immediate delivery on many sizes.

Mail coupon at once for Bulletin 101A containing engineering drawings of cylinder, mounts, mounting brackets, capacity chart and other data.

ORTMAN-MILLER MACHINE CO.
25 143rd Street,
Hammond, Indiana

☐ **Have representative call**
☐ **Send Bulletin 101A**

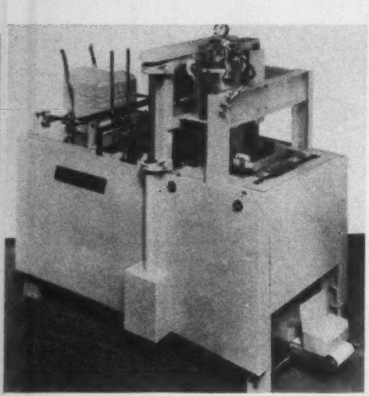
Name________________Position______

Company________________________

Address________________________

City____________Zone____State_____

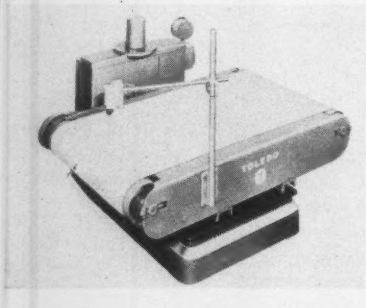
Circle 693 on Page 19



Tray & Carton Former

Model PG can form trays and cartons from cardboard blanks at speeds up to 70 per minute. Machine will handle blanks from 5 to 22 inches long by 3½ to 16 inches wide. In operation, the carton or tray blanks are automatically fed from an inclined magazine. A uniform glue pattern is applied to end flaps. A feature of the forming machine is a closed glue system which reduces cleanup time. The blanks are formed into trays or cartons and the glued sections are held firmly in position until the glue is set. The finished units are then delivered on a moving conveyor, ready for filling. **Peters Machinery Co.,** 4700 Ravenswood Ave., Chicago 40, Ill.

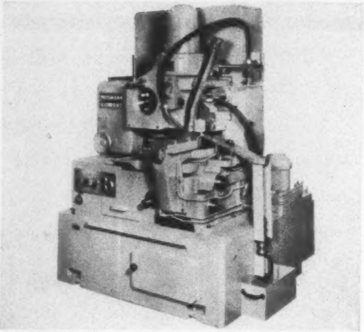
Circle 408 on Page 19



Automatic Checkweigher

Machine can continuously check-weigh each bag, carton, box, package, can, or tube in a production line at speeds up to 40 items per minute (depending on size) with an accuracy of approximately one part in 3000. It can handle items weighing from 50 to 200 lb. Unit is equipped with a belt-type motorized conveyor on the weigh section. Adjustments for changing from one package weight to another are made by resetting poises on beams that are housed in a locked enclosure. Model 9460 can be furnished with remote zone indication stations which provide a continuous visual check of the operation. A pilot light unit can show the weight zone (*Under, OK-Light, OK, OK-Heavy, Over*) into which each item falls. Magnetic counters can provide numerical data that can be used in controlling packing or processing machine operations. **Toledo Scale, Div., Toledo Scale Corp.,** Toledo, Ohio.

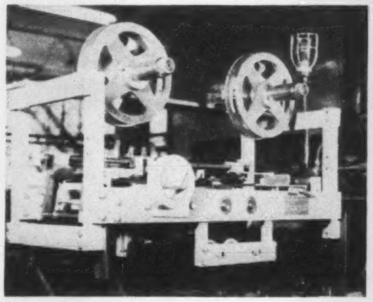
Circle 409 on Page 19



Gear Shaper

Line of gear shapers is designed for automatic or semiautomatic production of spur and helical gears of both internal and external types, racks, sprockets, and other special profiles. Model SV-00 (shown) can handle spur and internal gears up to about 6-pitch, has a cutter diameter of 4 inches. Tapered-teeth cutting attachments are available to permit the cutting of relieved coupling gears. In the shaping of cluster gears, an attachment locates the cutter for shaping a second gear in relation to the first one cut. A swiveling support arm is provided to support the clamping arbor and pinion shafts. Rack cutting attachments are also available. These attachments are direct-driven by the generating feed through a lead screw and nut, and mount on the table of the machine. Racks with either straight or tapered teeth may be cut. To switch from the production of spur gears to helical gears, a straight guide in the ram spindle is replaced by a helical guide, the lead of which corresponds to that of the cutter to be used. **Michigan Tool Co.,** 7171 E. McNichols Rd., Detroit 12, Mich.

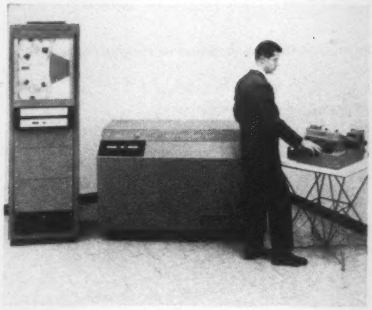
Circle 410 on Page 19



Web Splicer

Designed to be mounted on the frame of web consuming equipment, unit automatically splices in registration and does not require stopping the machine for roll changes. The splicing action is automatically triggered by the trailing end of the depleting roll. Designated 25 Series, the unit is available in two models (for 6 and 12-inch web width), with different specifications to accommodate the needs of many styles of wrapping machines. Web speeds of up to 200 fpm can be accommodated. The splicing mechanism is mechanically timed by the wrapping machine. **Butler Automatic Machine Inc.,** 205 Broadway, Cambridge 39, Mass.

Circle 411 on Page 19



Magnetic Tape Unit

Designed for use with company's digital control computer, magnetic tape unit (at left in illustration) is applicable in systems for on-line data collection in chemical and petroleum pilot plants and simulation and data reduction centers. When used with the computer, which incorporates an analog-digital converter, large volumes of data can automatically be collected from more than 1000 sensing instruments, converted to digital form, and stored on magnetic tape at a rate of up to 2560 readings per second. After the data is collected, specific information can be searched from the tape and re-entered into the computer for analysis.

Magnetic tape unit consists of a magnetic core buffer with from one to eight magnetic tape transports. Data is transferred to and from the computer's magnetic drum memory by the buffer. The buffer holds one block of data (128 computer words of 18 bits each), which corresponds to one track on the magnetic drum. The transport operates at a speed of 75 ips in the read and write modes and 160 ips in the rewind mode. Data is recorded on the

As easy as plugging in your electric shaver...

Wherever you use compressed air...

...just

PLUG IN THE POWER

with the HANSEN Series RL QUICK-CONNECTIVE Ring-Lock Coupling

- Tough...compact...smaller...lighter.
- Handles more air—with minimum pressure drop.
- Quick connection and disconnection.
- Instant automatic flow or shut-off.
- Handles any job in your shop using ¾" to ⅛" connections—from the air line to the air tool.
- Locking ring provides positive lock ... tight fit. Equipped with automatic sleeve lock.
- All Series 2-RL Sockets and Plugs are interchangeable—likewise all Series 3-RL Sockets and Plugs. Eliminates all need for various size couplings in hook-up—makes it easy to keep stock of parts in balance—holds inventories to a minimum.

Socket, when disconnected, automatically shuts off air by leak-proof seal of metal valve against rubber valve seat.

Write for the Hansen Catalog... a ready reference when you want information on couplings in a hurry.

Quick-Connective Fluid Line Couplings for
AIR • OIL • GREASE • HYDRAULIC FLUIDS
WATER • VACUUM • STEAM • OXYGEN • ACETYLENE
REFRIGERANTS • GASOLINE • COOLANTS • LP-GAS

REPRESENTATIVES IN PRINCIPAL CITIES
SINCE 1915 QUICK-CONNECTIVE FLUID LINE COUPLINGS
THE HANSEN MANUFACTURING COMPANY
4031 WEST 150th STREET • CLEVELAND 35, OHIO

Circle 694 on Page 19

THE MARK OF QUALITY

BARBER
COLMAN

Wheelco
Instruments

Built-in leadership—

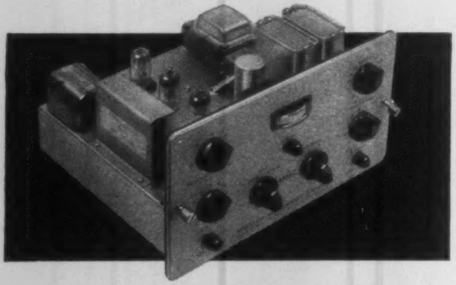
No need to wait . . . get with "field-proved"

There's no need to wait for new designs or hold up a recorder purchase until you're sure that the features you've heard about really work. Wheelco potentiometer recorder controllers — whether circular or strip chart — have the features you want *right now.*

Why settle for less when Wheelco recorder controllers offer you all these as standard — *at no extra cost:*

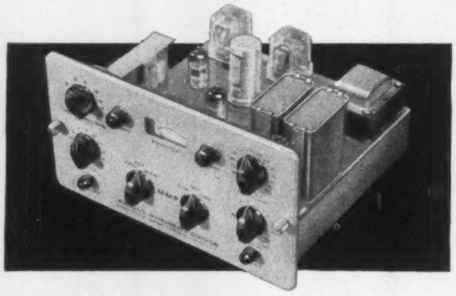
1. **CONSTANT VOLTAGE SOURCE** — proved in more than three years of field operation and available at no extra cost. Silicon diodes eliminate batteries and standard cells.
2. **QUICK RANGE CHANGE** — no soldering, just loosen 5 screws to replace range change brackets.
3. **PLUG-IN COMPONENTS** — downtime is sharply reduced and repairs can be made without tying up equipment with Wheelco pioneered plug-in components.
4. **ACCESSIBILITY** — inspection, adjustment and cleaning of complete instruments are simplified. Swing-out design

MM SERIES CONTROLLERS FOR PROPORTIONAL RESET AND RATE ACTION



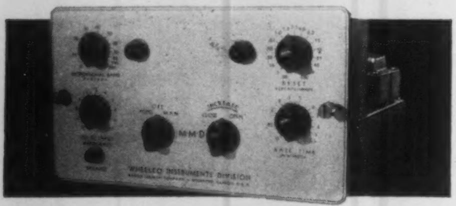
MMC CURRENT OUTPUT TYPE

Flexible in adaptation to final control elements including saturable reactors, electropneumatic transducers, electrohydraulic transducers; as well as other compatible electric systems.



MMP POSITION TYPE

Can operate a valve, valve positioner or other positioning device. Reset action is adjustable from 0.6 to 100 repeats per minute, rate action from 0 to 5.5 minutes.



MMD DURATION TYPE

Regulates input by adjusting on-time of a contactor on either electrical or fuel-fired installations. Ideal when upsets are fast and recovery slow or when large and frequent.

AUTO
OFF
MAN
MP
PROP. BAND
GAIN
RESET
OPEN
STOP
CLOSE
WHEELCO INSTRUMENTS DIVISION

MP PROPORTIONAL POSITIONER

Mounts in the instrument, provides proportional control by modulating the position of final control element as a linear function of the value of the measured variable.

the recorders advanced design

W H E E L C O
8
6
10
4
12
2
14
0
16

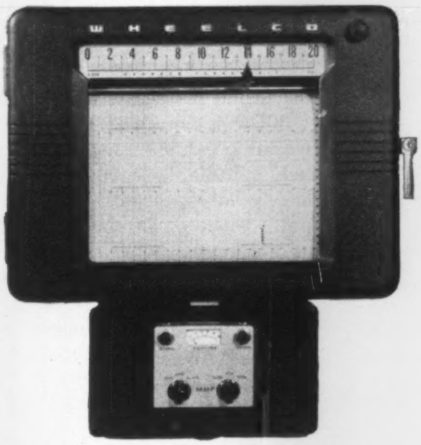
of principal elements on all Wheelco recorders permits fast adjustment, chart change, etc.

5. **SIMPLE CHANGE OF BALANCING SPEEDS** — changing a 15-second recorder to a 2-second recorder requires removing 3 steps of gearing. The two-phase balancing motor remains the same for all speeds.

ALSO FIELD-PROVED CONTROL FORMS WITH EXCLUSIVE MAGNETIC MODULATORS — Proportional rate and reset action on round and strip chart instruments offered by MM series controllers of the current output, position, or duration type.

SERIES 2000
ROUND CHART RECORDERS AND RECORDER CONTROLLERS

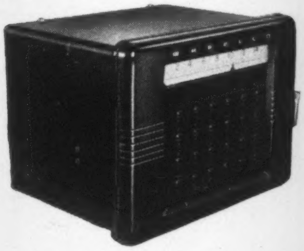
are also self-contained, null-balancing potentiometer instruments, the newest in the Wheelco line. Pen speeds are 1, 4, or 20 seconds at 60 cycles a-c. The 12-in. diameter chart has a calibrated width of 4⅝ in. Instrument accuracy is ± ¼ of 1% for all scale spans of pyrometric range. External control point setters are optional. All standard chart speeds are available; also a complete range of control forms including three-function type.



SERIES 8000
RECORDERS AND RECORDER CONTROLLERS

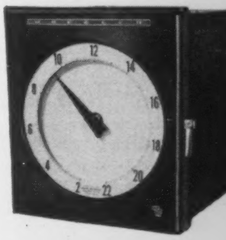
Self-contained, null-balancing electronic instruments designed for long life and trouble-free service. Wide range of models provides for measurement, indication, control, and permanent recording of temperatures and (with transducers) other variables such as speed, strain, ph, and any other quantities that can be resolved into electrical signals. Multipoint recorders handle up to 24 points at speeds from 3 to 24 inches per hour. Multibank (scanner) setups permit recording 144 or more points. Shown at left is recorder controller with automatic reset in tamperproof cover.

Rounding out the Wheelco line



◀ Wheelco 9000 Series multiswitch indicators enable rapid checking of temperatures at as many as 108 stations. More stations require only an additional switch housing cabinet.

Circular scale 3000 Series indicators and Indicating Controllers have large, bold, distant-reading scales and generally parallel construction of 2000 Series recorders described above. ▶



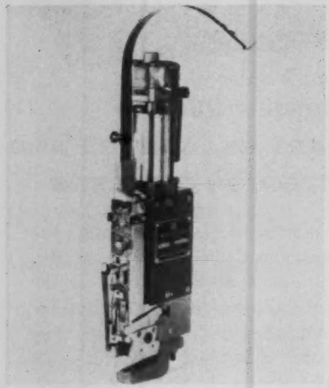
BARBER-COLMAN COMPANY

Dept. W, 15108 Rock Street, Rockford, Illinois, U.S.A.

Industrial Instruments • Automatic Controls • Air Distribution Products • Aircraft Controls • Small Motors
Overdoors and Operators • Molded Products • Metal Cutting Tools • Machine Tools • Textile Machinery

tape in groups of 384 lines, with each line containing six information bits, a timing bit, and a parity-checking bit. A safety feature is a series of built-in alarms and error-sensing signals which assures that the data is not lost through incorrect tape operation. **Thompson-Ramo-Wooldridge Products Co., Div., Thompson Ramo Wooldridge Inc.**, P. O. Box 90067 Airport Station, Los Angeles 45, Calif.

Circle 412 on Page 19



Wire Stitcher

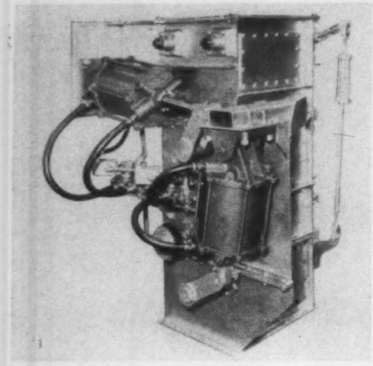
Air-actuated wire stitcher can accommodate wire sizes from No. 27 to 25 round and No. 21 by 25 flat. Designed for assembling or packaging work, multiple units can be mounted side by side to stitch one workpiece with several stitches at one time. Units can be positioned to stitch downward or upward, horizontally, or at any angle. Model L has a quick release lever which permits easy detaching of the stitcher head from the frame casting. **Acme Steel Co.**, 135th St. & Perry Ave., Chicago 27, Ill.

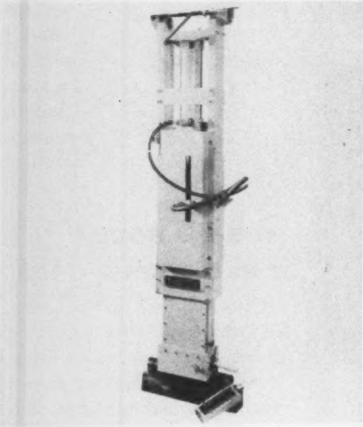
Circle 413 on Page 19

Conveyor Gate Lock

Gate lock discharge mechanisms are applicable in pneumatic conveying systems such as those which handle abrasive materials. Three sets of gates, actuated by a master cam, pass material down through the lock in successive stages. One set of gates is always closed to keep pressure constant. The upper gate acts as a batcher, while the air-tight lower and middle gates act as seals. The lock in the illustration is designed to move phosphate rock both to and from a surge bin. It will handle material at 20 tons per hour with 15 psi positive pressure above the gates. **Dracco Div., Fuller Co.**, 4063 E. 116 St., Cleveland 5, Ohio.

Circle 414 on Page 19

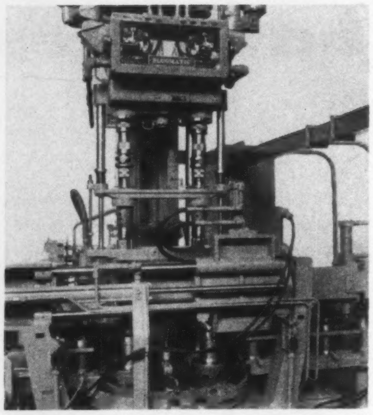




Metal Marker

Pneumatic machine is capable of marking pipe, tubing, and couplings with code letters and figures. Model 1600 can be placed in a production line and used in connection with automatic stencilling, length measuring, and weighing equipment, or it can be operated as a separate unit. A separate impact system is provided for each stamp, with the depth of impression controlled at each impact cylinder. Stamps are retained in an impact-resistant rubber removable holder. In operation, a master cylinder lowers the holder onto the material to be marked, then a sequence pressure valve sets off individual impact cylinders. After marking is completed, the individual cylinders return to their up or cocked position, and the master cylinder raises the unit off the pipe. **M. E. Cunningham Co.**, 1025 Chateau St., Pittsburgh 33, Pa.

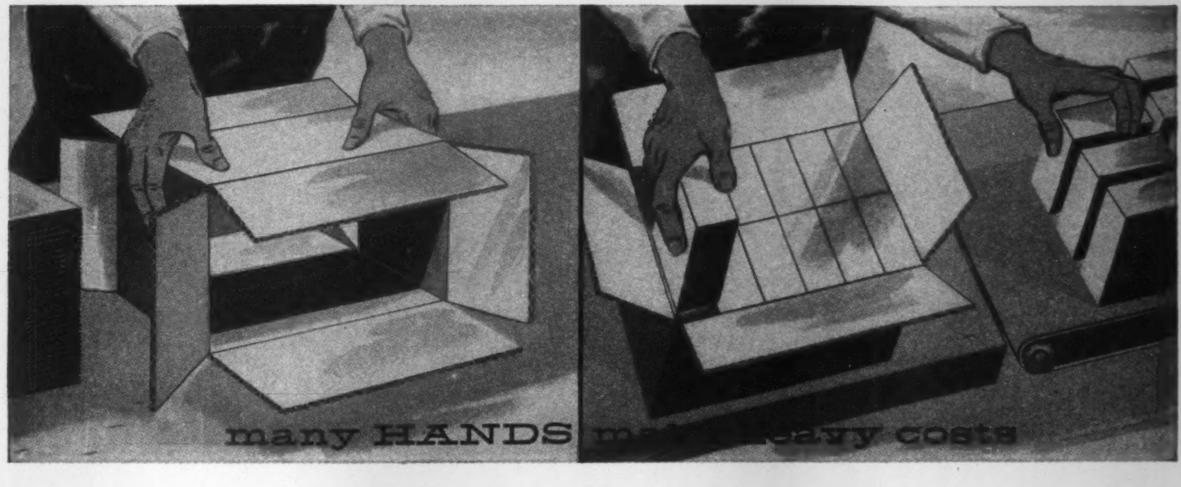
Circle 415 on Page 19



Vertical Honer

Double-spindle machine automatically hones cast iron cylinder sleeves at a rate of 144 parts per hour at 80 per cent efficiency. Model 307-2 is equipped with separate hydraulic cylinders for reciprocating each spindle independently at infinitely variable rates from 10 to 75 fpm. Included in the machine are an automatic hone expansion feature and automatic bore-to-bore sizing controls. The hone expansion feature provides automatic, rapid expansion and collapse of the hones. The sizing controls provide independent spindle honing action until final bore size is reached.

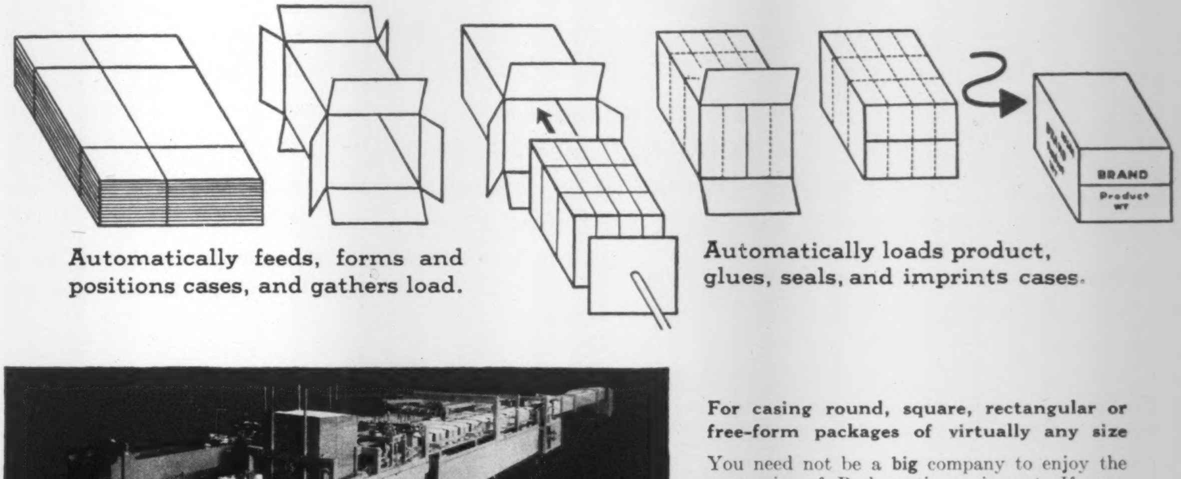
A 2-position rotary index table, 18-inches in diameter, is mounted on a fixture table. The index table rotates through 180 degrees, is equipped with four fixture subassemblies with full-floating compensating adapters. A transfer bar with expansible mandrels loads and unloads the parts in pairs. Limit switches control the indexing of the table. Two clamping brackets on vertical slides are cylinder-actuated through lever systems to hold the thin-walled parts rigidly in place for honing. The honing cycle begins automatically when the parts are clamped. If a part is not in place or fixtured properly due to


many HANDS make heavy costs

let Packomatic®
T.M. Reg. U. S. Pat. Off.

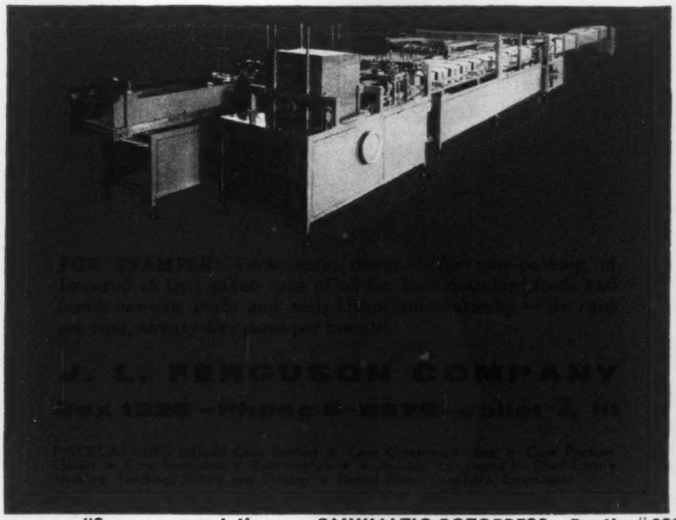
equipment do any or all your casing operations

AUTOMATICALLY



Automatically feeds, forms and positions cases, and gathers load.

Automatically loads product, glues, seals, and imprints cases.



[illegible]

J. L. FERGUSON COMPANY

[illegible]

[illegible]

For casing round, square, rectangular or free-form packages of virtually any size

You need not be a **big** company to enjoy the economies of Packomatic equipment. If your volume requires even one person to hand-form cases, hand-fill, hand-seal, or hand-imprint them, then a Packomatic machine can be a sound investment. Only a minute or two of attention at infrequent intervals is needed even for a **complete** automated Packomatic **line,** capable of matching the output of a dozen pair of hands. And in addition to reducing direct labor production costs Packomatic can, by utilizing end-opening shipping cases, reduce your paper-board costs up to 25%. And mechanically end loaded cases are stronger because the flaps give added resistance to weight and shock. In addition they stack better because their uniformly flat sides enables keying of pallet loads. Write, wire or phone us for facts on how to reduce your case packing costs.

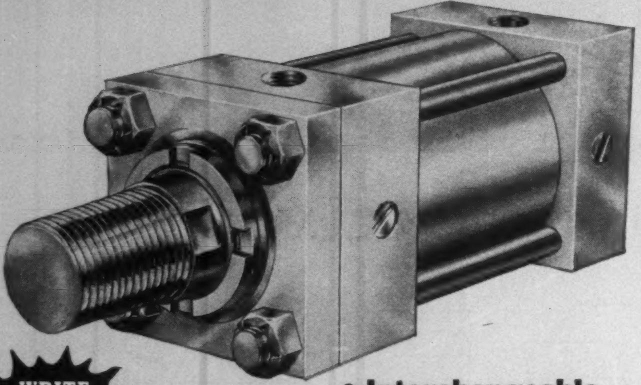
"See our revolutionary OMNIMATIC-ROTOPRESS. Booth #823—Nov. PMMI SHOW—New York Coliseum"

For Smooth, Precise, Sure Power

SP

NEW

HIGH-PRESSURE
HYDRAULIC CYLINDERS



WRITE FOR CATALOG 117 TODAY!

- Interchangeable
- 100% J.I.C. Standards

2000 PSI (3000 PSI non-shock)
12 Bore Sizes: Compact 1⅛" thru 12"

Exclusive SP Features:

Quick Change Externally Removable Cartridge
Self-contained unit, easy to remove for servicing—no need to loosen tie rods or dismantle the cylinder.

Interchangeable Cushion Adjustment and Check
Permits maximum installation flexibility; no clearance problem due to space-saving flush design; easy to adjust.

"Clinch-Tite" End Seal
Maintains a leakproof seal at all pressures. An increase in internal pressure reduces the radial clearance at the pilot fit, eliminating "O" ring extrusion.

Heli-Coil® Insert Piston Lock
Permits quick, easy rod service without loss of thread strength; conforms to rigid aircraft standards.

A-766A

PROVEN QUALITY · SP · CYLINDERS · CHUCKS · SPEED · PERFORMANCE

FREE Engineering Service
Representatives in principal cities
Phone or Write Today

Find us fast in the 'Yellow Pages'

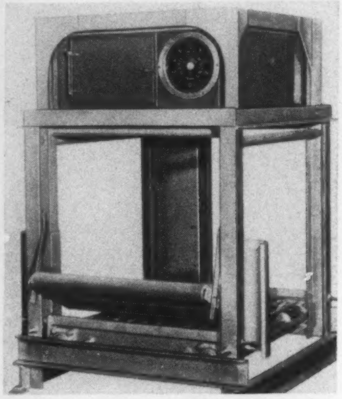
THE S·P MANUFACTURING CORP.
30201 Aurora Rd. • Solon, Ohio

A BASSETT COMPANY • IN GREATER CLEVELAND • ESTABLISHED 1916

Non-Rotating and Rotating AIR and HYDRAULIC CYLINDERS • VALVES
POWER CHUCKS • COLLET and DRILL PRESS CHUCKS • ACCESSORIES

part irregularities, the honing cycle will not begin. **Barnes Drill Co.**, 836 Chestnut St., Rockford, Ill.

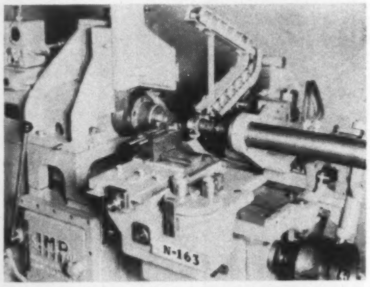
Circle 416 on Page 19



Conveyor Checkweigher

Weighing unit has a conveyor suspended under the plate scale, is designed for installations where low floor clearance is necessary or where spillage conditions would interfere with the operation of a scale placed under the conveyor. Unit, designated Model CDAU checkweighs, indicates, and registers package weights automatically. It is available in sizes from 18 to 36 inches, with ranges up to 200 lb and speeds up to 20 units per minute. Accuracy is ±1/10 lb of preset weight. **Thayer Scale Corp.**, 105 Thayer Park, Pembroke, Mass.

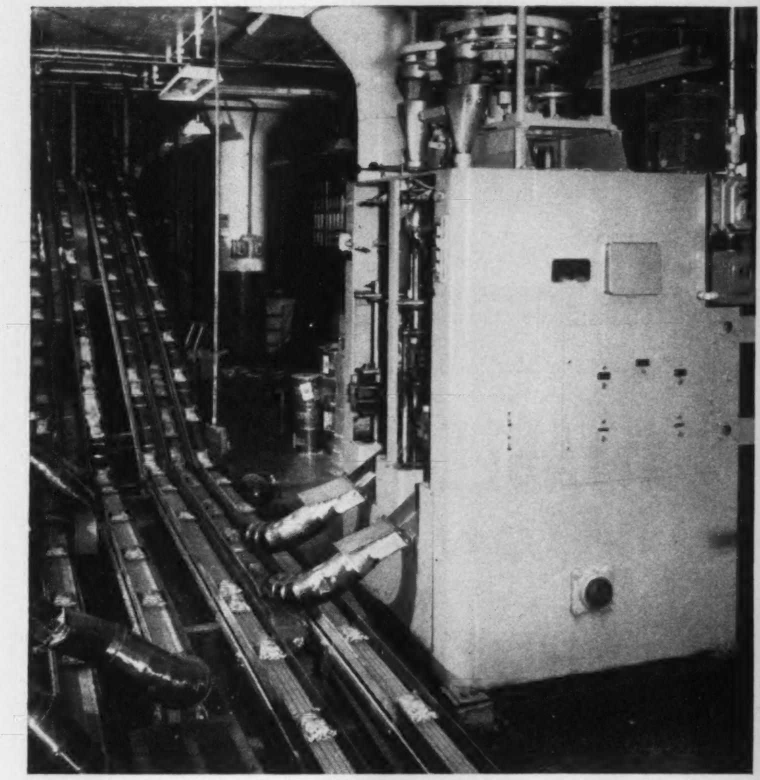
Circle 417 on Page 19



Machine Tool Loader

Automatic loader is designed for use with lathes to feed heavy couplings into a cradle, where they are picked up by an injector head and chucked in an air-operated chuck. The machine turns the outside di-

Circle 697 on Page 19



Why General Mills chose Robo-Wrap for Pick-A-Pack

This new Robo-Wrap at General Mills' Chicago plant will soon be joined by 2 more machines—because it has been proved that Robo-Wrap increases the efficiency and economy of their packaging operation.

The Robo-Wrap forms, fills and seals pillow packages. Under production line conditions at General Mills, the Robo-Wrap cruises at 100 bags a minute and can run at 120 . . . it provides a better seal and fewer rejects even at these high speeds because its unique hand-over-hand action holds jaws in sealing position for a longer time . . . it minimized work stoppages due to torn paper roll stock because the combination mechanical and hydraulic jaws exert a strong, jerk-free pull . . . it is easily adaptable to handle a variety of other products.

Robo-Wrap packages in cellophane, paper, poly, plastic or laminates. See how it can answer your needs for speed, dependability, easy maintenance and adaptability.

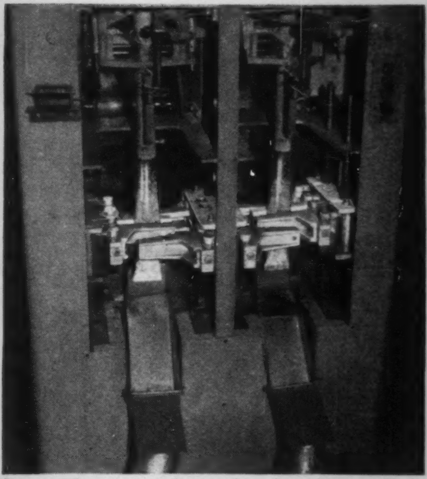
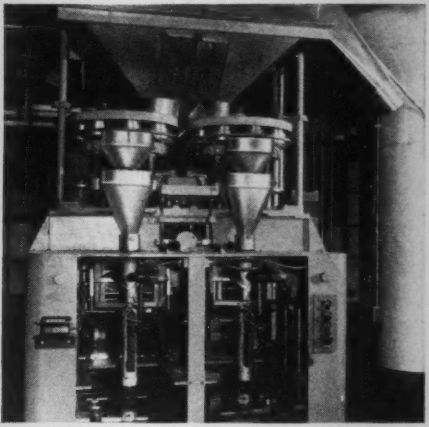
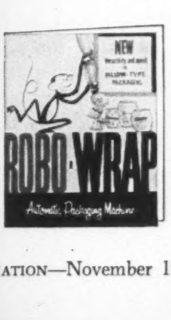


Photo shows hand-over-hand sealing action. Lower jaws, now disengaged, start to go up and pass on the outside of still-engaged pair of jaws.



Robo-Wrap versatility permits many different feeding arrangements. At General Mills, there is a volumetric feeder leading from storage hopper supplied from floor above.

General Mills Pick-A-Pack Package offers five tasty breakfast foods—Wheaties, Cheerios, Kix, Trix, and Sugar Jets—in one attractive carton.



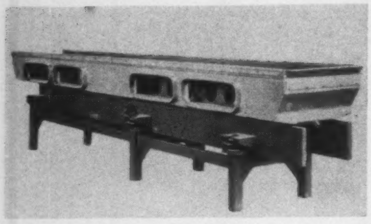
Write for Illustrated Robo-Wrap Folder that demonstrates features and advantages important to you.

LYNCH
CORPORATION
Anderson, Indiana

Circle 698 on Page 19

ameter, forms a radius on the flange, and chamfers the bore on the coupling. The finished piece is automatically ejected, picked up by a safety finger, and dropped into a discharge chute. With the use of the automatic loader, a production rate of 450 pieces per hour can be accomplished. The combination lathe and loader can also be used for turning parts such as small pistons, bushings, and gear blanks. **Seneca Falls Machine Co.**, 17 Fyfe Bldg., Seneca Falls, N. Y.

Circle 418 on Page 19



Continuous Dryer

Line of conveyor-dryers can be used for either drying or cooling of moving materials, is available in direct or indirect types. The direct dryer (shown) carries granular material in the range of $\frac{1}{4}$-inch down to 60 mesh on a stainless steel conveying screen through which drying air or gas is passed. The indirect dryer carries fine material on a solid-plate conveying surface which is heated from below by low pressure steam or hot air. A feature of the dryers is a variable-amplitude drive which permits adjustment of speed of travel and depth of material. **Jeffrey Mfg. Co.**, Columbus, Ohio.

Circle 419 on Page 19

GEM-17 DIAL INDEX TABLE
TRUE GENEVA MOTION

FOR FAST, *ACCURATE* AUTOMATION OF ASSEMBLY *and* MACHINING OPERATIONS

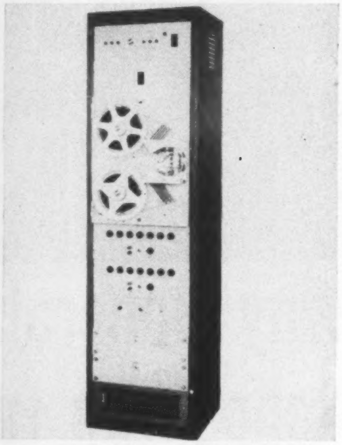
This new, high precision index table is accurate to plus or minus 0.001 in. on a 13 in. dia. work circle; can position work in as little as ½ sec.; indexes a 1,000 lb. fixture load.

BASIC SPECIFICATIONS: Standard Number of Stations—6, 8 or 12; 3 and 4 skip. Motor—Rotary air, fluid, or electric. Dial Plate—17 in. dia. standard; larger plates available. Rotation—Either direction. Interlock—Limit switch operated directly off locking bolt. Weight—200 lbs.

Gray engineers will help you adapt GEM-17 to your use. For recommendations, send specifications of your application. Illustrated brochure GE-21 and prices on request.

GRAY EQUIPMENT COMPANY
13600 Ford Road • Dearborn, Michigan • Telephone: TIffany 6-7573

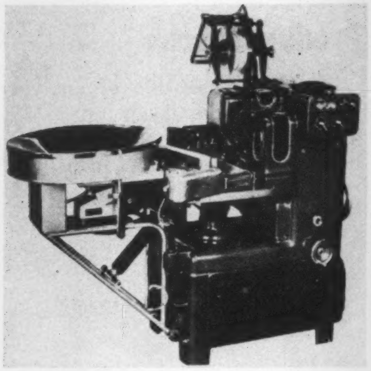
Circle 699 on Page 19



Magnetic Tape Tester

Unit is suitable for testing the quality of the coating on magnetic tape. It will automatically locate and indicate tape flaws that can be classified as noise or drop-out. Parallel checking facilities simultaneously check for each class of tape flaw. Model 3298 includes a record and playback system with the necessary logic circuit provisions to detect drop-outs in any channel. It will stop the tape at a predetermined location for visual examination and possible correction. The noise test is performed by detecting residual signals on the tape with a separate playback head, after passing over an erase head. Tape speeds up to 150 ips and pulse densities to 550 per inch can be accommodated with tape widths from $\frac{1}{2}$ to 1-inch on 10 $\frac{1}{2}$-inch reels. **Potter Instrument Co. Inc.**, Sunnyside Blvd., Plainview, L. I., N. Y.

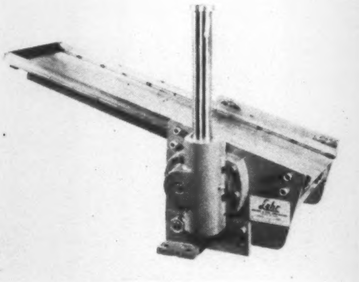
Circle 420 on Page 19



Twist Wrapping Machine

Suitable for twist wrapping tablets and both filled and solid candies, Model 85 can attain speeds up to 500 per minute. In operation, the candy or tablets are automatically fed from a hopper into the pockets of a 45-division feed disc. Continuously revolving twisters effect a neat, tight wrap. Unprinted or continuously printed cellophane or waxed paper can be used for twist wrapping with or without an understrip of backed foil. A screw adjustment varies the tension applied to the cut wrapper. Twist heads are adjustable to handle various lengths of candy. Changeover from one size of candy to another involves replacing the feed disc, a lifting plunger, and a paper feed change gear. **Package Machinery Co.**, East Longmeadow, Mass.

Circle 421 on Page 19

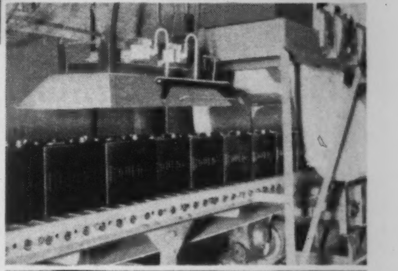


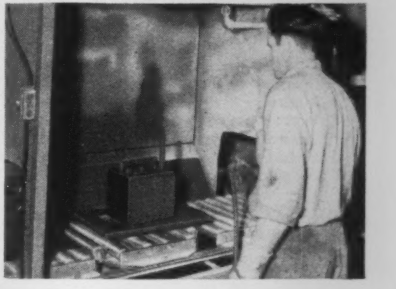
Press Unloader

Tray-type reciprocating unloader is adaptable for removing parts and blanks from mechanical presses. Movement of the press ram controls the unloader. In operation, the tray slides underneath the die during the upstroke and receives the

Multi-plant conveyor conversion problem solved with

Standard Conveyor stock units





Gould-National makes full conversion in 90 days

Gould-National Batteries, Inc., makes batteries for hundreds of sales organizations, each having its own color combinations in trade marks and brand names, some requiring as many as three distinct shades. And Gould-National, to insure distribution of fresh batteries everywhere in the country, manufactures in 16 strategically located plants throughout the United States.

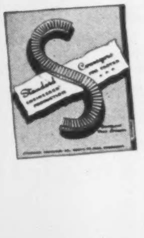
Battery manufacture is a highly standardized, mass-production operation. Economical application of painted multiple colors on the cases posed real problems in methods and equipment. The conversion at Gould-National required equipping 16 plants simultaneously with painting equipment and conveying systems coordinated with existing production lines.

Methods engineers at Gould-National made the multi-plant conversion in the record time of 90 days . . . using Standard Conveyor stock units, including Handidrive power unit, with big savings in cost. And what do these engineers say about Standard Conveyor? "Best possible method for our type of operation!"

Illustrated are scenes from the St. Paul plant of Gould-National. Line was designed to produce 3,000 multi-colored batteries in 50 different sizes and colors per day.

When you have a materials-handling problem, call Standard — more than 50 years of conveyor engineering experience. Standard Conveyor Company, General Office: North St. Paul 9, Minnesota.

OVER 50 years of conveyor experience



Call the Standard engineer listed in your classified phone directory or write direct for Bulletin 309 —address Dept. EE-11.

Standard

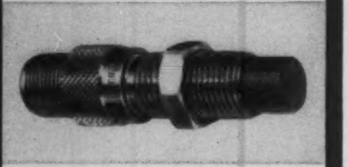
GRAVITY & POWER CONVEYORS

Sales and Service in Principal Cities

Circle 700 on Page 19

NOT
1 CENT
OF CARE NEEDED
IN 5 YEARS

. . . no wear . . . no failure . . .
controls continuous production
in big automotive plant

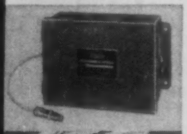


EPL non-contacting
PROXIMITY SWITCH
detects/controls
ferrous/non-ferrous metals

Save costly down time. EPL Proximity Switches far outlast mechanical switches . . . no contacts or moving parts to wear out. Unaffected by dirt. Models are available to operate when submerged in oil or water. Does more in less space and costs less than other proximity switches. Detects metal pieces at rates up to 60,000/min. Unlimited applications. Available in standard, subminiature and extended range models.

Advantages over other switches

- no mechanical linkage
- meets JIC requirements
- operates for years without attention
- oil and water proof
- low pickup cost (from $18.50)
- special pickups to operate 100' from unit



Proximity Transducer System includes pick-up, control unit and cable

Engineering file gives all the facts and applications

Electro® Electronic Equipment

ELECTRO
PRODUCTS
LABORATORIES

4501-A Ravenswood, Chicago 40. Ill.
Canada: Atlas Radio, Ltd., Toronto
9675

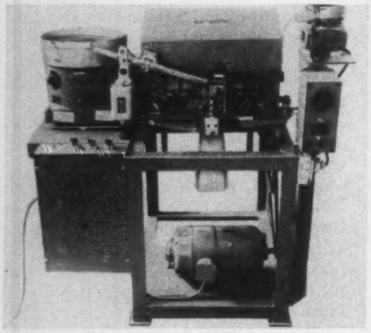
Circle 701 on Page 19

part or blank. During the downstroke of the press, the tray emerges with the part, at which time the part slides off the tray and drops in a bin or onto a conveyor. The unloader is available in two models—rack-driven and cable-driven. With the rack-driven model, the full tray cycle is actuated by a rack mounted on the press ram. The tray instroke of the cable-driven model is energized by a steel cable attached to the press ram and the outstroke is powered by an air cylinder. Change gears are available to vary the tray stroke from 10 to 20 inches on small models with up to 36-inch trays, and from 12 to 30 inches on large models with up to 72-inch trays. **Lahr Machine & Tool Co.,** 3404 Maplewood Ave., Toledo, Ohio.

Circle 422 on Page 19

Terminal Capper

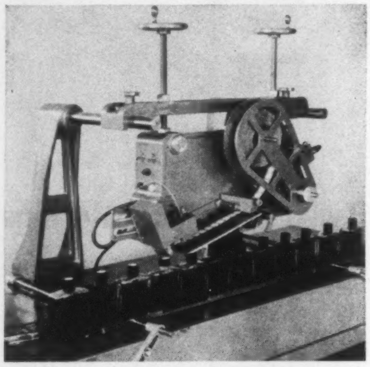
Designed for the automatic assembly of miniature tubular components, machine is particularly suitable for capping resistor bodies with press fitted terminal caps. Model RAM-1 can handle round, polygonal, solid, and split caps. Production rate is 3000 units per hour. Machine can be individually tooled for a wide range of cylindrical cores or flanged bobbins ranging from 1/16 to 5/16-inch in diameter. A feature of the unit is bulk loading of vibratory hopper feeds to automatically maintain full parts chutes. Another feature is that the machine is self clearing in the event that defective parts are fed into the hopper. **Halm Instrument Co. Inc.,** Glen Head Rd., Glen Head, L. I., N. Y.



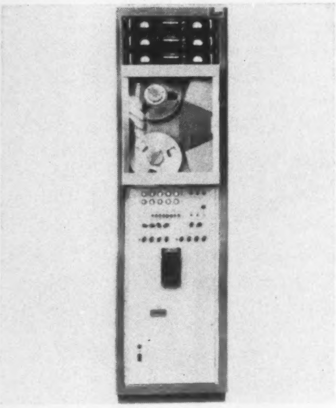
Circle 423 on Page 19

Product Labeler

Machine is capable of applying pressure-sensitive labels up to 3¼ inches in width to items such as blank bottle caps, jars, cans, and various types of prewrapped packages containing candy, stationery, foodstuffs, and frozen vegetables. The backing paper is automatically removed from the labels which have been previously die-cut by a converter. The head mechanism which dispenses the labels can be raised or lowered to meet variations in product sizes. An available coding attachment is designed to print price information, size data, etc., on the labels as they are dispensed. **Derby Sealers Inc.,** Derby, Conn.



Circle 424 on Page 19



Magnetic Tape Converter

Instrument permits use of digital magnetic tape as a direct input to automatic graph plotters and other devices. Data need not be transfered from the tape to punched cards. Unit has solid state switching circuits and can be adapted to

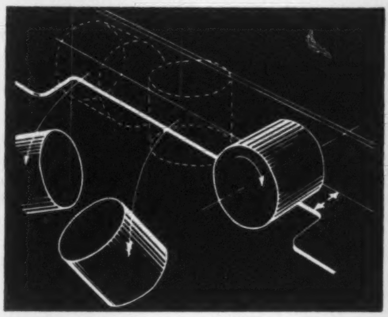
practical automation ideas....no. 3

Storage Unit that Thinks for Itself!

When should a part be stored temporarily between operations? When should it pass immediately to the next operation? A Gear-O-Mation storage unit makes this decision after checking if the loader is full. It either positions the part on the loader for immediate processing, or puts it in "storage" for later demand feeding.

Impossible!—But it Works!

An orientor that repeals the law of gravity? Impossible? Maybe, but Gear-O-Mation has one that's hard to believe.



Parts roll down an "L"-shaped track which narrows to *slightly less than one-half width of part!* Correctly rolling parts roll on across for further processing; others just tumble off and go back to the start of the track.

What's your concept of automation? A vast array of inter-connecting machining operations untouched by human hands? Actually, all automation comes down to a series of small devices—feeders, orientors, escapements, conveyors, etc. Dozens of typical devices are illustrated in Gear-O-Mation's "Idea File". Ask your Gear-O-Mation field engineer to show you his.

Magnetic Handling with Fabric Belt

Small irregular shaped parts can be elevated or directed into orientors with fabric belts backed by permanent magnets in such a way that only those correctly positioned will enter the demand-feed chute.

Single Loader for Multiple Feeder

Where it is desired to load parts into a multiple feeder (as for a heat-treat oven) they can be picked off a single chute, dropped into a multiple "Velvet-Drop" (patented) feeder which keeps all channels of the multiple feeder loaded, provides temporary storage to keep them full.

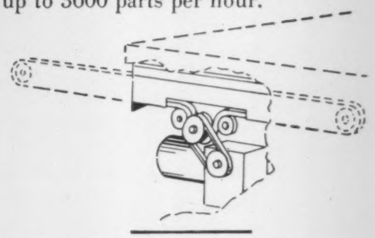
Most people think of automation as something built into the original installation. That's a good way to do it, but you don't have to do it that way. If you want to automate your existing operation this can be done very effectively, too. In either case, Gear-O-Mation's experts can automate your machining operation to any degree desired—make it deliver all of the potential designed into it.

Track: Fast, Clear and Adjustable!

A simple answer to handling parts of different dimensions—as when a design change is made—is an adjustable-track conveyor. Side plates and rails are moved in or out, quickly adjusted for smaller or larger part width. Parts roll on spring steel rails. Soils, chips, cuttings, etc., fall through, making the conveyor self-cleaning.

One Belt Does Two Jobs

Sometimes you can use the same belt to unload parts from one machine and load them into another by using a center drive gear head motor with a wrap-on sprocket. A typical Gear-O-Mation installation of this type handles up to 3600 parts per hour.



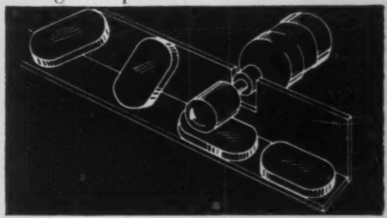
Automation begins with the coupling of two machines, often through a simple elevator and a gravity chute. From this you can go almost to infinity. Gear-O-Mation has the experience and ingenuity to point the way and design the equipment for the exact degree of automation your operation requires and warrants.

Handling Parts in Pre-Set Groups

In automation, parts don't have to be handled one-at-a-time only. Sometimes it works better to process them in groups of preset quantities, using a feeder that meters and releases the precise number required. For example, in one plant, eight plastic fishing reels are aligned and placed on a spindle for simultaneous group winding.

Pencil Wheel Orientor

A small grinding wheel can be used to orient light parts by knocking down all parts which try to pass in an upright position. The light 'bite' of the wheel gives positive action but does not damage the part.



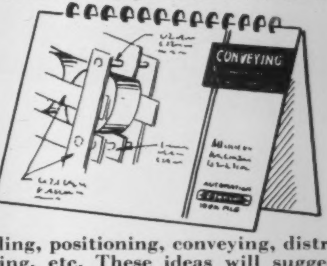
Gear-O-Mation doesn't believe in its customers having to pioneer untried ideas. Where a new principle is involved, we make sure of it first. Mostly, however, we go back to established principles we all KNOW will work.

Demand Storage for No-Roll Parts

Where parts can't roll you can move many rows of them through storage by a simple, moving disc with fixed guide rails. One such Gear-O-Mation unit collects, stores and feeds up to 3000 small parts.

NEW "IDEA FILE"

Every Gear-O-Mation field engineer now carries with him an "Automation Idea File." It contains sketches and details of practical answers to many parts handling problems—orienting, feeding, positioning, conveying, distributing, etc. These ideas will suggest variations to suit your exact needs. Have a Gear-O-Mation field engineer go through the "Idea File" with you soon! Use the handy coupon below.



GEAR-O-MATION

DIVISION OF MICHIGAN TOOL COMPANY

7171 E. McNICHOLS RD. • DETROIT 12, MICH.

GEAR-O-MATION
Division of Michigan Tool Company
7171 E. McNichols Rd., Detroit 12, Mich.

Yes! I want to see the time- and money-saving ideas in your new "Idea File." Have your field engineer show it to me soon!

Name____________________

Company____________________

Street____________________

City____________________

Circle 702 on Page 19

PRESSURE SWITCHES

for twice-a-second or twice-a-year operation!

An Oil-Dyne pressure switch has repeatability—it will function properly every time, whether it operates several times a second—or once every six months! Liberal use of low-friction materials and a completely new (patent applied for) design that eliminates all contact between O ring and cylinder walls combine to keep piston from sticking—assures perfect operation every time, any time. 50-5000 psi, explosion-proof. Single and duplex models. For hydraulic fluids and gases (freon, oxygen, etc.). Write for illustrated brochure.

PIONEERING MINIATURIZED HYDRAULIC ACTUATION

- PUMPS
- CYLINDERS
- PRESSURE SWITCHES
- VALVES
- ACCESSORIES

OIL-DYNE INC.

2115E West Marquette Road, Chicago 36, Ill.

Circle 703 on Page 19

New! REAR-PROJECTION-TYPE **IN-LINE DIGITAL DISPLAY**

WITH ONE-PLANE PRESENTATION

Series 10,000
Character Size—1" high

IDEAL FOR Electronic or Electrical Test Equipment and Instruments, Control Equipment, Production and Inventory Controls, etc.

Specifications include no moving parts, fast easy installation, minimum of maintenance, low unit cost, and long operating life.

Price Per Unit **$18.00** Quantity Prices On Request

Write Today for Complete Specifications

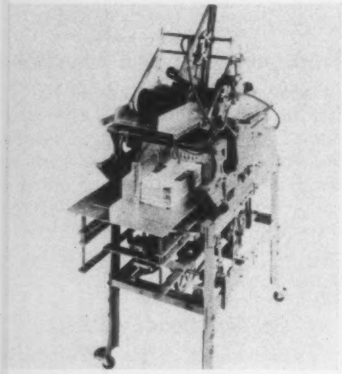
Representatives in Principal Cities

INDUSTRIAL ELECTRONIC ENGINEERS, INC.
3973 Lankershim Boulevard
North Hollywood, California

Circle 704 on Page 19

magnetic tape from any digital computer. Features of the converter include a point density selector, automatic file and record run-up, parity check, off-scale error count or stop-plot, and provision for omitting records which contain specified characters. **Benson-Lehner Corp.**, 11930 W. Olympic Blvd., Los Angeles 64, Calif.

Circle 425 on Page 19



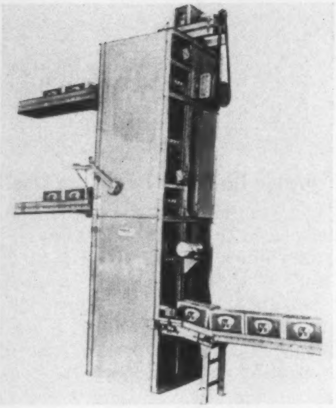
Automatic Labeler

Equipment can apply both spot and wrap-around labels to cylindrical containers such as glass bottles, jugs, tin cans, canisters, and aerosol containers. Features of Model 4-A include an escapement which allows only one container to feed in at a time, an automatic pressure roll which presses down the label, and automatic ejection of the labeled container. Container sizes from $1\frac{1}{8}$ to 7 inches in diameter and up to 9 inches in length can be handled. A rising label plate will accommodate a label stack up to 5 inches high. **Long & Co. Inc.**, 4125 Hayward Ave., Baltimore 15, Md.

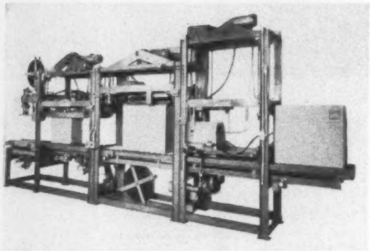
Circle 426 on Page 19

Multilevel Conveyor

Index-type vertical case conveyor can automatically receive, space, transport, and discharge individual packages at a rate of up to 20 cases per minute. It will accommodate either one or two packages per carrier. Size of packages the machine can handle ranges from 10 to $15\frac{1}{2}$ inches in width, 12 to 36 inches in length, and 7 to 15 inches in height. Capacity is up to 180 lb per carrier. The conveyor can be changed from a one-package per carrier operation to a two-package system by means of a pushbutton arrangement. Hinged doors provide for two or more discharge levels for packages leaving the unit. **Alvey Conveyor Mfg. Co.**, 9301 Olive St. Rd., St. Louis 32, Mo.



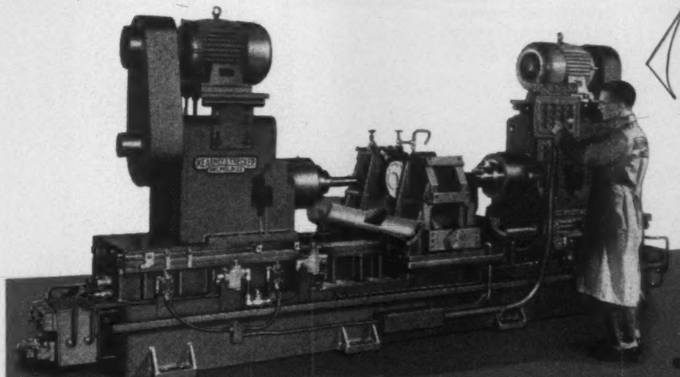
Circle 427 on Page 19



Case Taper

Equipment will automatically adjust to random-size cases, close the top flaps, and tape seal the top and bottom simultaneously. In operation, Model TS-30-SS&M receives cases from a gravity conveyor; indexes the cases; automatically adjusts to case size; closes the top flaps; and applies gummed tape to the top and bottom of a case. It then rolls the extended ends of tape onto the end panels for complete sealing. Machine will accommodate rolls of tape up to 24 inches in diameter. It is also equipped with a tape coder and can handle rip-cord tape with pull tab for easy opening of the sealed case. **General Corrugated Machinery Co. Inc.**, 141 W. Central Blvd., Palisades Park, N. J.

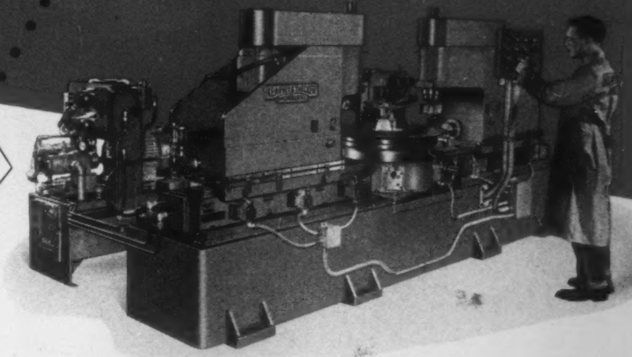
Circle 428 on Page 19



CONSTRUCTION INDUSTRY

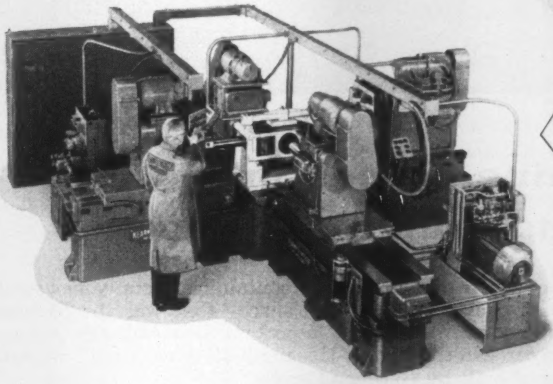
Only one setup is required to rough and finish bore, finish counterbore and face both sides of a tread roller for tractor-type construction equipment. Workpiece is hydraulically clamped . . . seven sizes of rollers can be machined. This method replaces a turret lathe using two setups. New rate is 13 pieces per hour.
Production up — 100%.

Kearney & Trecker builds PRODUCTION MACHINE TOOLS FOR EVERY INDUSTRY



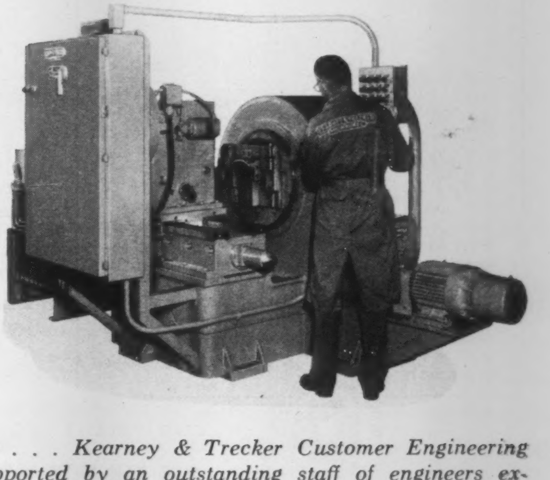
AIRCRAFT INDUSTRY

Rotary feed, bed-type machine with two opposed vertical spindles mills both sides of aluminum pump body flange to critical thickness and smooth finish *at rate of 76 pieces per hour.* Unit is versatile . . . as many as eight types of pump bodies are milled using only separate fixtures and cams.



ENGINE INDUSTRY

This unit bores four holes in engine block simultaneously . . . replaces horizontal milling and boring machine that worked just one hole per setup. Interchangeable inserts allow operations on any of four different workpieces. One feed slide unit handles interchangeable heads.
Production — 10 pieces per hour . . . up — 400%.



ELECTRIC POWER INDUSTRY

Two-spindle machine mills both inside and outside radii of curved alloy steel turbine blade section in a single pass *at three times the former feed rate.* Versatile 360° drum fixture handles 81 different blade sizes without overtravel on rapid stroke for extremely short cycle time.
Production up — 300%.

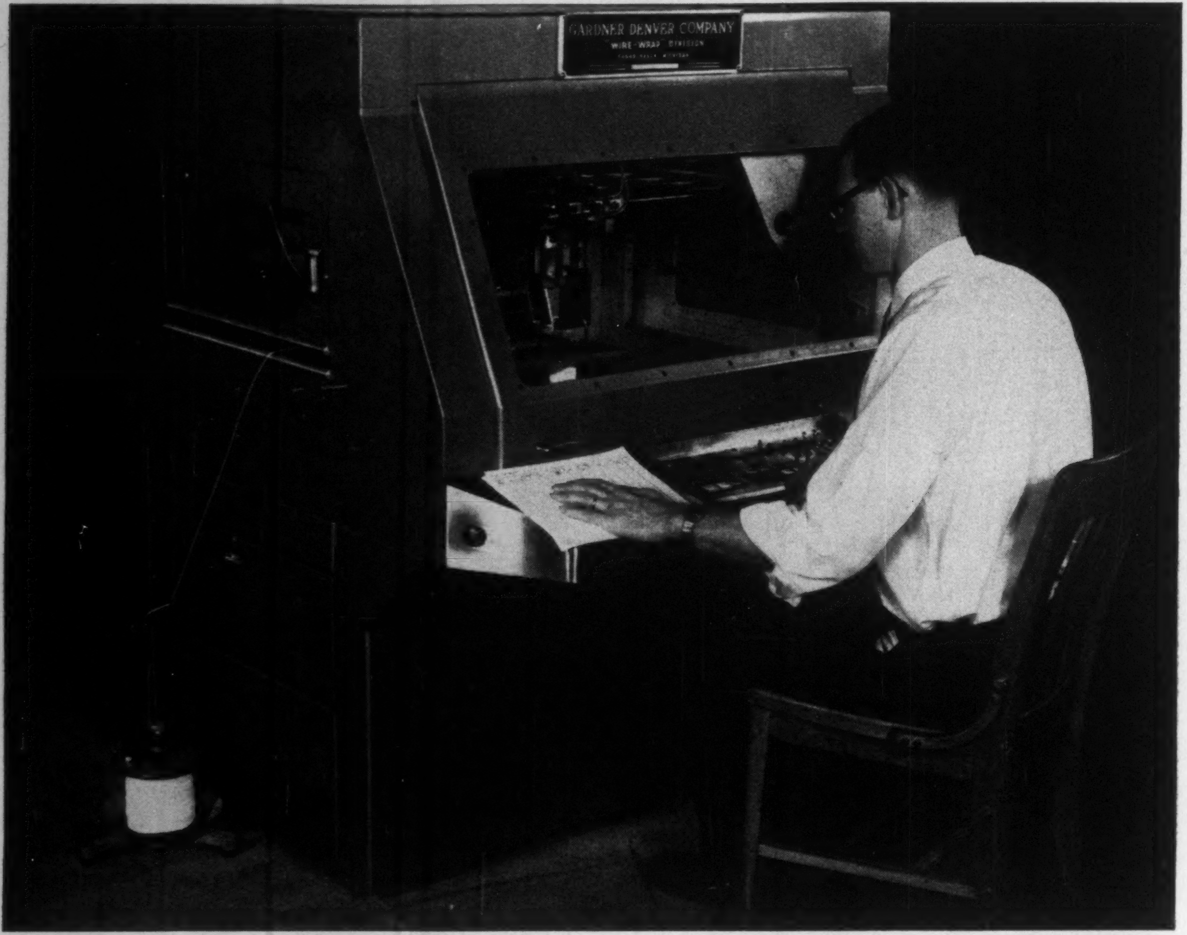
Write for bulletin SMD-57 on your company letterhead or phone — GReenfield 6-8300 . . . Direct Distance Dialing Code No. 414.

KEARNEY & TRECKER MILWAUKEE ®

SPECIAL MACHINERY DIVISION

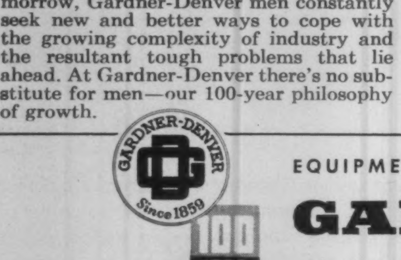
6800 W. National Ave. • Milwaukee 14, Wis.

SINCE 1898 . . . *Kearney & Trecker Customer Engineering Service — supported by an outstanding staff of engineers experienced in production milling machine design and application — combined with the finest and latest machine tools in an ultra modern plant, is always ready to solve your production problems.*



Automatic Wire-Wrap® machine speeds production on vital military project

FOR THE CHALLENGE OF TOMORROW



Ever looking ahead to the challenge of tomorrow, Gardner-Denver men constantly seek new and better ways to cope with the growing complexity of industry and the resultant tough problems that lie ahead. At Gardner-Denver there's no substitute for men—our 100-year philosophy of growth.

To produce electronic equipment containing literally *thousands* of connections packed into a small space—that was the problem facing engineers recently on an important new military project. The solution came in the form of this unique "Wire-Wrap" machine—designed and built by Gardner-Denver.

Operated either manually or automatically by punched cards or tapes, the machine can place 10,000 wires on a 20″ x 20″ modular terminal board. It wraps all terminals for lastingly secure, solderless connections—in a 10″ x 10″ wrap area—and puts as many as three connections on each terminal, completing the entire wrapping cycle for one wire in approximately six seconds.

This is just one more example of special machines designed and built for *reliability*—by Gardner-Denver. If you have a special problem in multiple operations of connecting wires, drilling holes, or fastening screws and nuts, it'll pay you to talk to a Gardner-Denver special machines engineer. Ask for bulletins.

GARDNER-DENVER Since 1859

100 1959 YEARS

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

Circle 706 on Page 19

AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems.

For detailed information and literature, use card page 19.

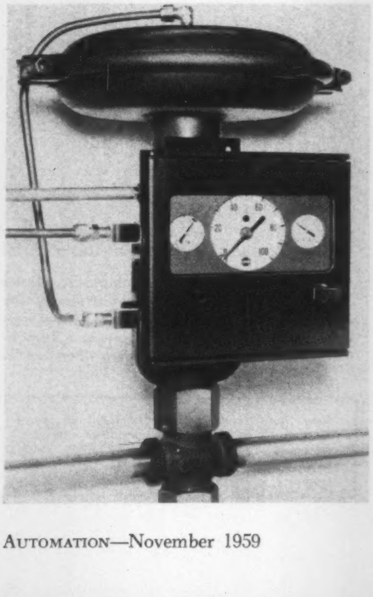
Motor starter features a draw-out, plug-in connector and fuse assembly which can be removed from the unit for ease of maintenance.

Starter for Large AC Motors

MEDIUM voltage ac motor starter can provide short-circuit protection and co-ordinated control for squirrel-cage, synchronous, and wound-rotor motors up to 3000 hp rated from 2300 to 4600 v. Unit, designated Limitamp, is offered by **General Electric Co.**, Schenectady 5, N. Y. Applications for this control unit can be found in pulp and paper mills, metal rolling and process industries, and rubber and plastics industries. It can be used for motors driving pumps, compressors, refiners, chippers, extrusion presses, and motor-generator sets.

A feature of the unit is the draw-out, stab-in contactor and fuse assembly which rolls out at the bottom of the control enclosure. With the high-voltage contactor assembly out, a swing-out low-voltage panel at the top of the control enclosure allows access to the removable barriers. The barriers partition off the incoming cable and bus compartments and when they are removed, there is enough space to install the incoming motor and power cable. As the contactor-fuse assembly is rolled back into position, self-aligning contacts automatically plug into the de-energized power circuit. Control power is also automatically engaged. With a grounding strap and door lintel in position, the control is ready to operate. A safety feature, called a "door forgetter," keeps the high voltage compartment door closed when the control is energized. Safety shutters between the high-voltage fuses and the incoming power bus isolate high voltage from exposed portions of the controller.

Circle 429 on Page 19

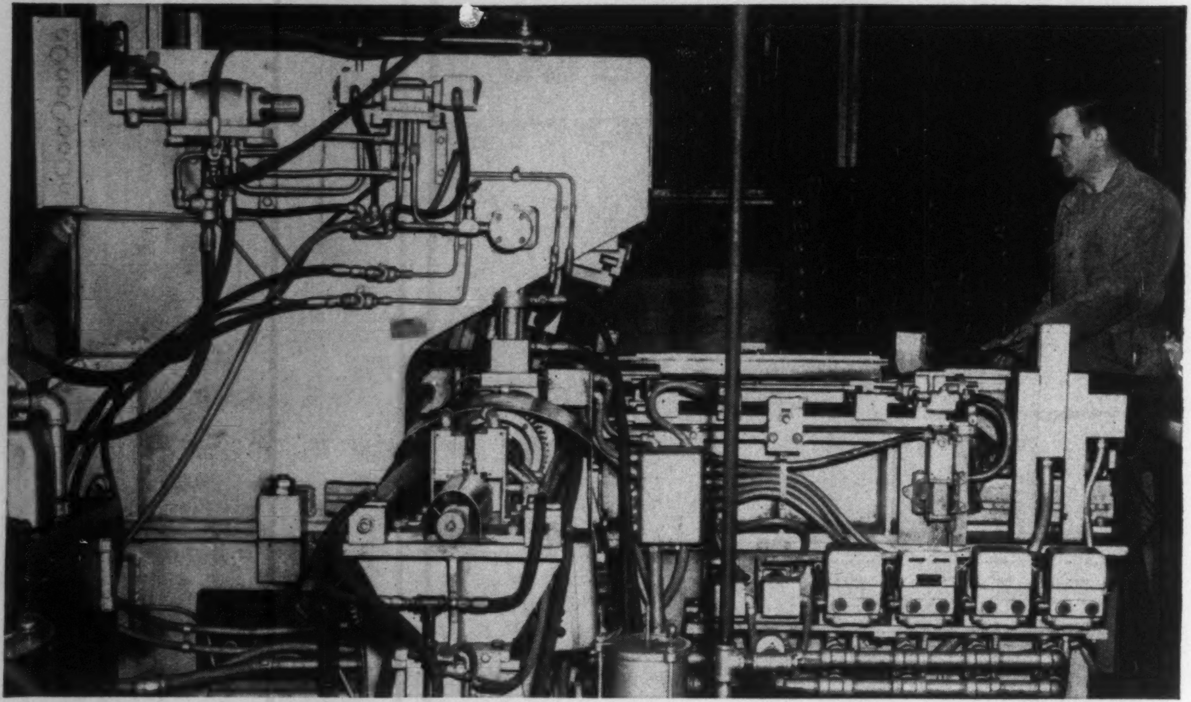


Indicating Controller & Valve Positioner

Combination instrument is capable of functioning as an indicating pneumatic controller for temperature or pressure and as a valve positioner to amplify air power to provide accurate and rapid positioning of a pneumatic diaphragm-operated control valve. In place of pneumatic feedback from a bellows assembly, the unit uses a mechanical feedback from the valve stem through a lever system. This action forces the valve to assume a position proportional to the controlled variable (within the proportional band).

Positioner can be mounted on the side of a conventional control valve to provide the combined functions of an indicating controller and valve positioner.

A rear mounting plate with three pairs of holes for vertical location, will accommodate most valve sizes. Final adjustment for valve stem travel from ⅜ to 4 inches is made in the lever system. A dial indicator inside the instrument case shows the valve position. This indicator can be useful for adjusting the instrument to match the valve stroke over the air pressure range. A standard instrument can use any air supply pressure from 20 psi to as high as 65 psi for increased posi-



This machine rolls and welds muffler shells. Hydraulic pressure and return lines are Aeroquip Flexible Hose Lines which replaced rigid tubing.

Hydraulic Line Leakage Problems Solved With Aeroquip Flexible Hose Lines

at Walker Michigan Division, Walker Manufacturing Company of Wisconsin

Semi-automatic metal forming and welding equipment is used at Walker Michigan Division's Jackson plant in the production of automotive mufflers. On equipment using rigid tubing, leaking hydraulic lines were a common maintenance problem. Tubing failures were caused by vibration of the equipment during operation.

Walker maintenance men solved this problem by replacing rigid tubing with Aeroquip Flexible Hose Lines. Assembled quickly in the plant using Bulk Hose and Reusable Fittings, these replacement hose lines have given long, trouble-free service.

If you have a fluid line problem of any kind, you can rely on your local Aeroquip Distributor to help solve it. He's a fluid line specialist. Call him today, or write us.

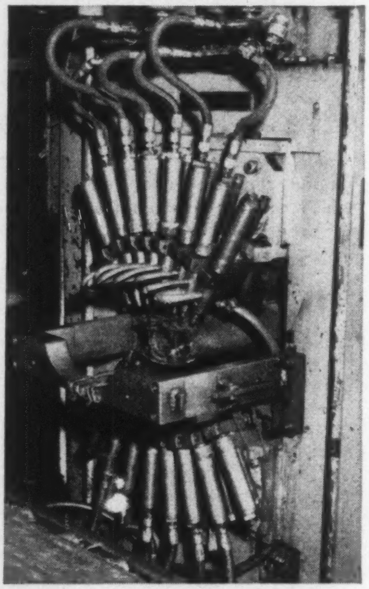
Aeroquip

REG. TRADEMARK

AEROQUIP CORPORATION, JACKSON, MICHIGAN

INDUSTRIAL DIVISION, VAN WERT, OHIO • WESTERN DIVISION, BURBANK, CALIFORNIA
AEROQUIP (CANADA) LTD., TORONTO 19, ONTARIO

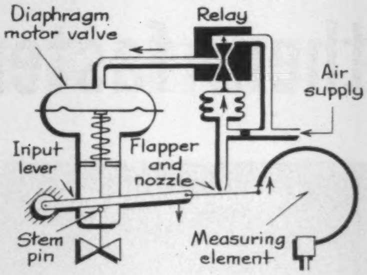
AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD



Aeroquip Hose Lines on this multiple transformer welder have given long, leakproof service since replacing steel tubing. Walker maintenance men keep a supply of Aeroquip Hose and Reusable Fittings on hand to replace tubing when needed.

New Industrial Catalog No. 204 is now available, covering the complete line of Aeroquip Hose, Fittings, Adapters and Quick-Disconnect Couplings. Write for your copy.

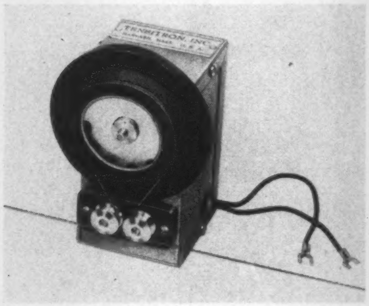
Circle 707 on Page 19



Schematic drawing of the basic operating principle. A decrease in measured variable moves the flapper toward the nozzle. Air pressure in the bellows increases, closing the relay exhaust port and increasing the output air pressure to the valve. The pin on the valve stem moves down, rotating the input lever clockwise. Through linkage, this motion reopens the nozzle and results in a new balance at the new valve stem position.

tioning power. The control set point knob can be within the instrument case, on the case door, or at a remote spot. **U. S. Gauge, Div., American Machine & Metals Inc.,** Sellersville, Pa.

Circle 430 on Page 19

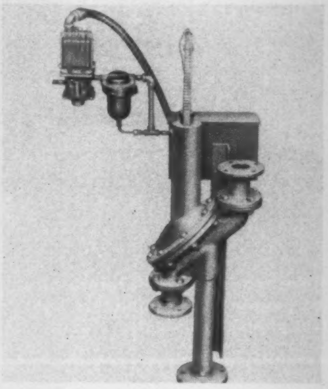


Tension Control

Applicable on coil winding machines, unit electrically applies tension, guiding wire or other filamentous materials around an expendable elastic cover. Without deforming the wire insulation or abrading sensitive filaments, nonslip traction is established between the filamentary material and an aluminum pulley. The elastic cover consists of two layers of contrasting colors. The outer layer is black and the inner one is yellow. When the traction surface wears, the yellow layer shows.

Because it is electrically operated, the tension control can be energized from a small control box within a reasonable distance from the tension wheel. The wheel can be mounted on the traverse of a coil winding machine or put in position against the surfaces where processing occurs. When the entire machine is stopped, the tension control automatically stops too. **Tensitron Inc.,** Harvard, Mass.

Circle 431 on Page 19

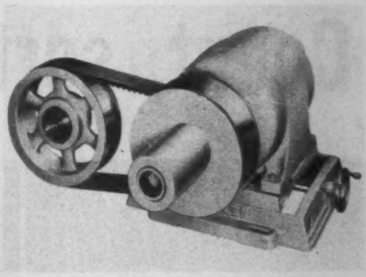


Controlled Volume Pump

Device is capable of handling abrasive slurries containing up to 60 per cent solids and discharging them at pressures up to 90 psi. It features a gentle diaphragm action which minimizes particle degradation. Pump consists of two hemispheres clamped together with a slack diaphragm between. The lower hemisphere is equipped with inlet and outlet check valves. The upper hemisphere is connected to an air supply by means of a three-way solenoid valve which alternately pressurizes and exhausts the chamber. A timer electrically operates the three-way valve.

When the upper hemisphere is exhausted, suction pressure forces liquid into the lower hemisphere through the suction ball checks. This action displaces the diaphragm upward. When the upper hemisphere fills, it is pressurized, and the downward movement of the diaphragm forces the liquid from the lower hemisphere through the discharge ball checks. By adjusting the timing mechanism, flow volume can be varied from 0 to 180 gph. **Milton Roy Co.,** 1300 E. Mermaid Lane, Philadelphia 18, Pa.

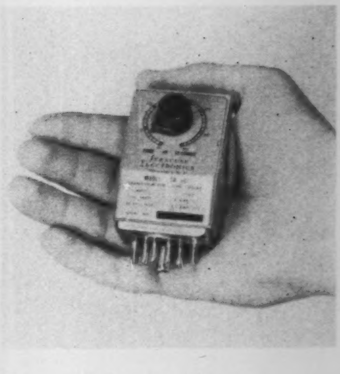
Circle 432 on Page 19



Variable Speed Pulley

Unit is furnished in 20 and 25 hp, with infinite speed adjustment over a 3:1 speed range. The drive has a class II rating, with service factors to 1.4. Pulley has an adjustable base for mounting 324U and 364 frame motors, plus a selection of controlling devices. A choice of companion sheaves provides a wide choice of operating speeds. **Lewellen Mfg. Co.,** 1420 Tenth St., Columbus, Ind.

Circle 433 on Page 19



Time Delay Relay

Transistorized time delay relay is designed for applications where accurate timing is required and where voltage fluctuations exist every time a motor starts under load. Model TR-301 is infinitely variable over a specified range from 10 milliseconds to five minutes. Switching capacity is 5 amp resistive at 120 v ac. Timing accuracy is 10 per cent of nominal and repetitive accuracy is better than ±2 per cent. Relay is potted with a special foam for protection against dust, moisture, and oil deposits. **Syracuse Electronics Corp.** 1014 E. Fayette St., Syracuse 10, N. Y.

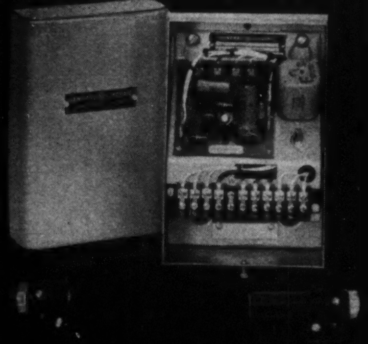
Circle 434 on Page 19

Count, sort, or inspect them faster

Self-contained relay

Low-cost; ideal for limit-switch-type application; includes a SP-DT output relay.

Transistorized relay



Features transistors; hermetically sealed plug-in relay; miniature light source, photocell holders.

General-purpose relay

GENERAL ELECTRIC
Control

A low-cost, highly reliable relay suited to counting, diverting, limiting and signalling jobs.

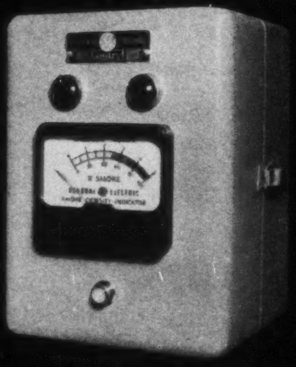
Explosion-proof relay

Watertight, explosion-proof; includes 3-inch lens, self-contained phototube, time delay.

Long-distance relay

Responsive *only* to light from accompanying light source; operates at distances up to 2,500 feet.

Smoke-density indicator

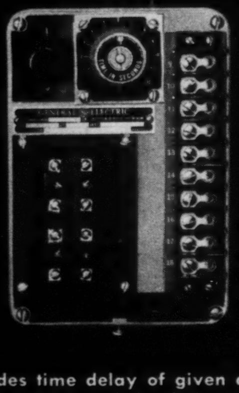


Measures smoke density, liquid turbidity, etc., and provides alarm when pre-set point is reached.

Voltage-sensitive relay

Detects voltage changes for meter operation, elevator-motor overspeed detection.

Electronic timer



Provides time delay of given duration, or set interval simply by setting dial at desired time.

Cut-off register control

Low-cost; features direct operation of solenoid, small scanner, timed reset and relay kits.

and more efficiently with modern G-E electronic devices

Your General Electric distributor offers a full line of simple, easy-to-use controls

Whether you're automating a production line . . . replacing obsolete machines . . . or, trying to get more out of present equipment . . . one of General Electric's photoelectric or electronic controls may help you gain faster, more efficient production.

Why? Because G-E photoelectric and electronic control devices are specifically intended to take the complexity . . . the labor . . . and the waste out of modern-day production. Combinations of these devices are applicable to virtually any industrial counting, sorting, signalling, protecting, diverting, detecting, or limiting job. And, chances are they will do the job at less initial cost—and lower operating cost—than the control methods you are now using.

CONSIDER THESE EXTRA-VALUE FEATURES

Bonus features you get with job-proved General Electric photoelectric and electronic controls include:

Fast response—Relays operate on light changes as short as 1/1000th of a second.

Versatility—G-E relays operate on light increase, decrease, time delay, reflected light, slow or rapid light change.

Dependability—Lamps operate 3,000 hours or more. Components are conservatively rated for long, maintenance-free life.

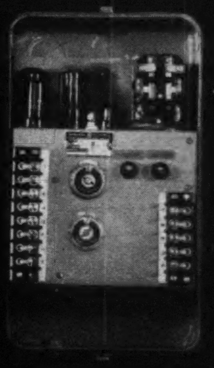
If you are not satisfied with the efficiency of your production operations, it will pay you to find out about G.E.'s complete line of control devices. Call your nearby G-E Apparatus Sales Engineer or Distributor. Or, send us the coupon below. *General Electric Co., Specialty Control Dept., Waynesboro, Va.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

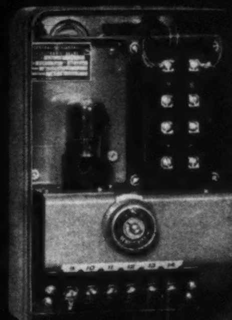
Circle 708 on Page 19

High-speed relay



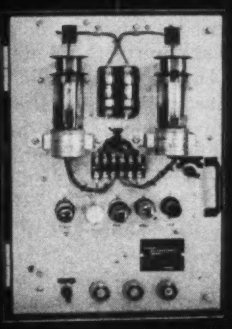
High-sensitivity; fast operating (600 ops. per min.); time delay, interlock, many other features.

Resistance-sensitive relay



Uses resistance changes to control a circuit; can operate motor to maintain liquid between two levels.

Side-register control



Accurately maintains lateral position of moving web in a process or machine; high-accuracy control.

SEND TODAY FOR *FREE* CATALOG

General Electric Co., Section D793-1
Schenectady 5, N.Y.

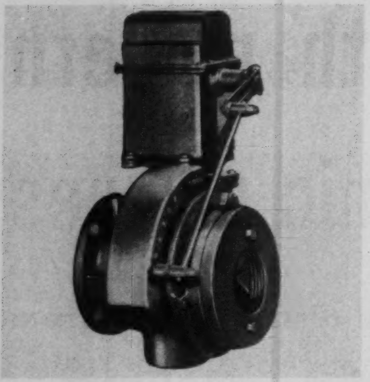
Please send me a copy of the new G-E Photoelectric Control catalog, GEA-6822, with description, specifications, and pricing data on the complete line.

Name ____________________

Company ____________________

Address ____________________

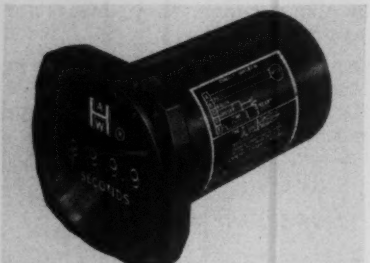
City ____________________ **State** ____________________



Proportioning Valve

Designed to handle manufactured gas, natural gas, propane, and butane, line of proportioning valves uses a two-in-one valve method to provide the proper blending required for any firing condition. This design insures that the air-gas mixture is identical with previous settings, as the control arm automatically returns to any position. The valve has nine individual gas-adjusting screws, giving an air-fuel ratio that can be adjusted precisely for each valve position. **Eclipse Fuel Engineering Co.**, Rockford, Ill.

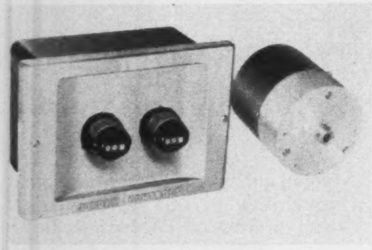
Circle 435 on Page 19



Stop Clock

Line of digital ac and dc stop clocks is capable of measuring time intervals over wide voltage and ambient temperature variations. Some of the applications include: Calibration of intervalometers, production testing of timing devices, and controlling various process functions during material fabrication. The digital ac clock (shown) can be used for 60 and 400 cps operations; the digital dc clock can be used for 20-30 v dc operation. A feature of the clock is an electrical reset which permits local or remote control or automatic operation where successive time intervals must be measured. Clock is available in two types of mounting—an AN type mounting and a flange mounting. **A. W. Haydon Co.**, Waterbury 20, Conn.

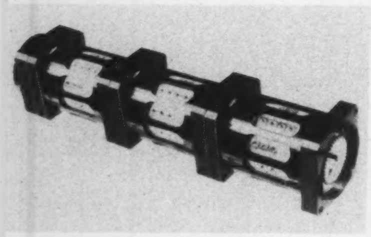
Circle 436 on Page 19



Electronic Limit Switch

Electronic limit switch senses and remotely limits position, weight, level, or pressure; is designed for applications where one or more trip points must be frequently reset as in sequencing and programming. Limits are set to accuracies of 1/5 of 1 per cent of full scale. Switch consists of two units—a setter and a sensor. One or more limit points are set in on individual dials of the setter (left in illustration). Each dial sets a precision potentiometer or resistor which serves in one leg of a bridge circuit. The sensor (right in the illustration) varies a resistance in the other leg of a bridge circuit. The sensor is usually a matching potentiometer, but it can be any resistance varying transducer. **Jordan Co. Inc.**, 3235 W. Hampton Ave., Milwaukee 9, Wis.

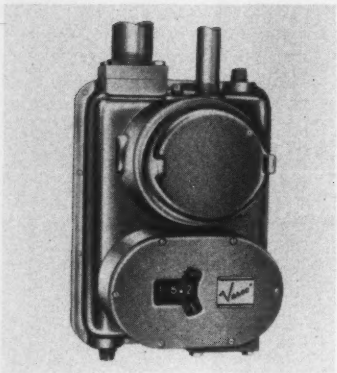
Circle 437 on Page 19



Shaft Position Encoder

Applicable on automatic machine tools and machinery, in automatic weighing, measuring, and counting systems, electromechanical type converter will translate mechanical position into a decimal digital code, providing a non-ambiguous readout for any shaft position. A 500 ma circuit makes it possible to pulse electric typewriters and card punching equipment directly, without an intermediate relay matrix. Model AP-124 has a maximum slewing speed of 1500 rpm; each revolution provides 10 counts. Readout accuracy is better than ½ digit, least increment. Unit uses a 10:1 step-down gearing between decades, any number of which can be provided. **United Precisioneers Inc.**, 23916 Craftsman Rd., Calabasas, Calif.

Circle 438 on Page 19



Liquid Level Gage

Power operated liquid level tank gage is designed to detect and display liquid level. It can be used on all types of cone roofs, floating roofs, and underground tanks of any diameter, up to 60 ft high, with pressure to 50 lb. Measuring part of the system consists of two-elements—a force measuring mechanism and a displacer. The force measuring mechanism consists of a torque tube, arm, and servomotor switching contacts. The displacer supported by the force measuring mechanism is always in contact with the surface of the liquid. The balance between the gross weight and the net weight of the displacer is visually displayed at the gage head by a numbered dial and counter mechanism. Accuracy of the gage is better than 1/16-inch; sensitivity is better than 1/64-inch; and repeatability is better than 1/32-inch. **Vapor Recovery Systems Co.**, Compton, Calif.

Circle 439 on Page 19

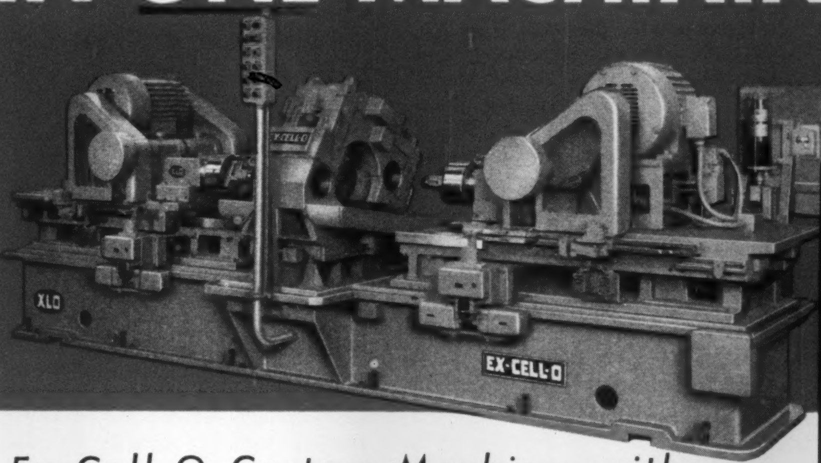
FROM ROUGH...

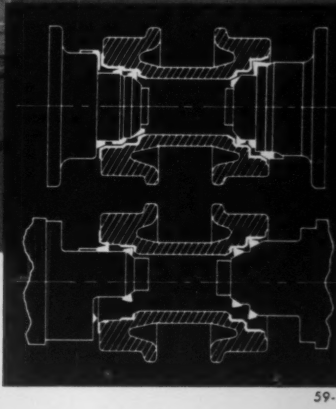
Heavy boring and plunge-facing

TO FINISH

Precision boring and facing

IN ONE MACHINING CYCLE





59-23

Ex-Cell-O Custom Machine—with quick-change tooling—speeds output of large, cast-iron track rollers

This Ex-Cell-O Custom Machine features precision—in a big way.

A track roller for rugged, off-the-road equipment, is clamped in the hydraulically-actuated fixture; the rest—from rough to finish—is automatic.

The part is first rough-bored on both ends at the same time. Then both slides retract and the fixture indexes into position for finish boring and facing at both ends, simultaneously. (Drawing, above-right, shows rough and finish tooling.) Slides again retract and the fixture is unclamped, ready for the next cycle. Easily changed tooling heads and clamping jaws permit precision machining of any of three similar components with minimum lag in production.

See your Ex-Cell-O Representative, or write direct for full details on Ex-Cell-O Custom Machines—specially designed with extended capacity for changing production needs.

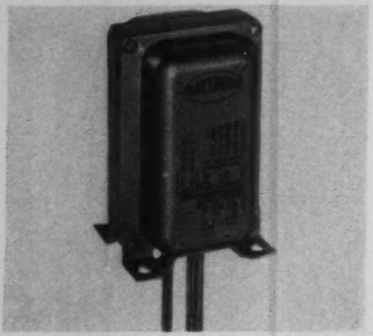
EX-CELL-O FOR PRECISION XLO

EX-CELL-O
CORPORATION
DETROIT 32, MICHIGAN

Machinery Division

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

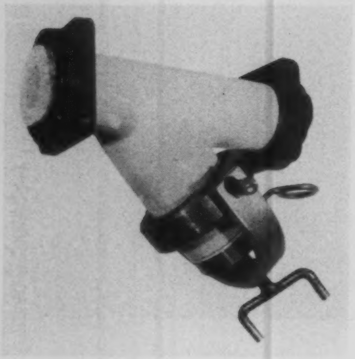
Circle 709 on Page 19



Regulating Transformer

Voltage regulating transformer provides regulated filament and plate voltages without any other circuitry. It can also be used ahead of other regulating circuits to provide extremely close regulation. Transformer maintains a voltage within ±3 per cent of rated output with line variations from 100 to 130 v. Unit is available in three models with an average dc input volts to filter of: 275 v dc at 50 ma; 385 v dc at 110 ma; and 380 v dc at 250 ma. **Industrial Apparatus Div., Raytheon Co.,** Manchester, N. H.

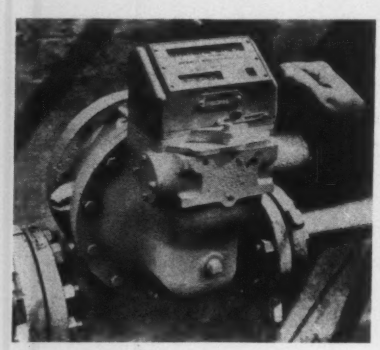
Circle 440 on Page 19



Porcelain Strainer

Device removes both coarse and fine solids before they enter chemical pumps, valves, or other process equipment. Body of the strainer is constructed of solid chemical porcelain, the end seal is of Teflon, and the connecting flanges of the strainer are malleable iron. The strainer element is made of fused porcelain sand, can be easily removed for cleaning or replacement. Three types of strainers are available—the coarse strainer has an average pore diameter of 250 mu; the medium strainer has an average pore diameter of 150 mu; and the fine strainer has an average pore diameter of 110 mu. **Process Equipment Div., Lapp Insulator Co.,** 106 Hall St., LeRoy, N. Y.

Circle 441 on Page 19



Liquid Meter

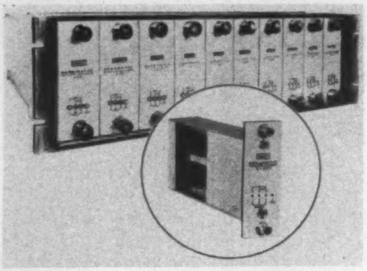
Adaptable for the food, chemical, petrochemical, pharmaceutical, and industrial processing fields, Model 2S is capable of measuring flows ranging from 20 to 100 gpm. When used on horizontal piping lines, the meter does not require a manifold or 45 degree elbow. Unit has a direct rotary flow—the liquid moves through the meter in a direct rotary path from inlet to outlet without any winding passages to obstruct flow. Minute clearances between the revolving measurement parts and the chamber wall create a liquid capillary seal which minimizes metal-to-metal contact. Feature of the meter is a variable speed device which varies the speed ratio between the meter and the register. A teflon shaft seal protects the register drive mechanism and register proper and a micro adjustment provides positive adjustment to allow for metering variations caused by changes in liquid properties and variables in the meter installation. **Meter & Valve Div., Rockwell Mfg. Co.,** 400 N. Lexington Ave., Pittsburgh 8, Pa.

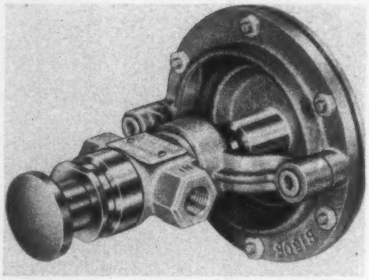
Circle 442 on Page 19

Voltage Divider

Transformer type, relay operated divider (Model X-551) can be used as a binary to analog converter. It can also be used for calibration and inspection applications. Ten divider units can be mounted across a standard relay rack and can be interchanged according to system design. Programming is by binary code which can be supplied from punched cards or tape. Linearity is 0.01 per cent and resolution is approximately 0.006 per cent. **Electro Measurements Inc.,** 7524 S. W. Macadam Ave., Portland 1, Ore.

Circle 443 on Page 19

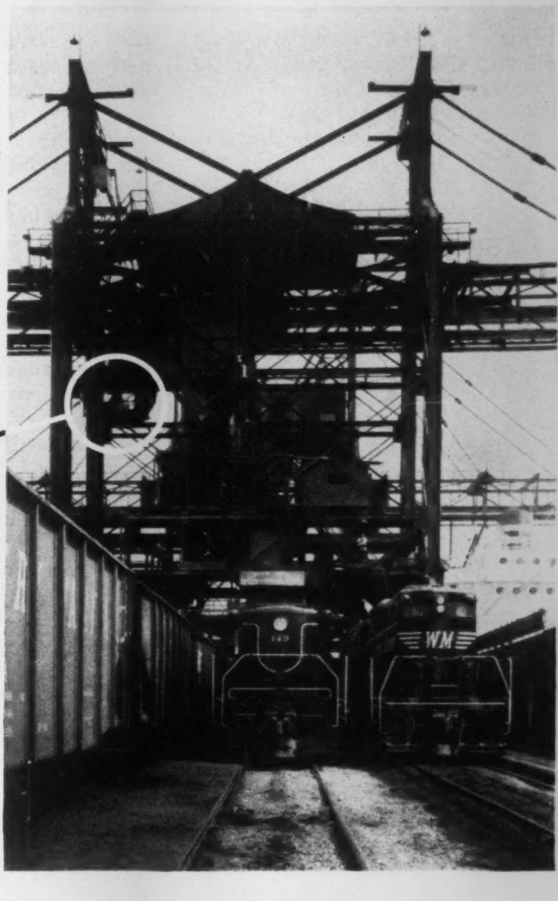




Automatic Valve

Line of control valves is designed for automatic interlocking of manually-controlled circuits. It can also provide manual operation of an automatically-operated system. Valve is available with 2, 3, or 4-way valve bodies, is suitable for use in air, oil, or vacuum service. Port sizes range from ¼ through 1 inch NPT. For interlocking, a stock diaphragm end section is fitted to a standard valve body, with a knob, lever, or other type of manual control mounted on the opposite end. Manual operation of the valve is unrestricted until the air is applied to the diaphragm end. When fitted with a return spring, the valve functions automatically, actuated by any 3-way pilot valve, instrument, or process control. With actuating pressure off, the valve can be operated manually. Valve is suitable for 20

Automation from crane to customer's office at the Western Maryland



After unloading ore from ship to railroad car, weighman in crane transmits data to yard office for automatic preparation of waybill and other documents.

Teletype Printer in a crane automates ore waybilling

As ore is transferred from ships to railroad cars at Western Maryland's Port Covington docks, a weighman high up in the control cabin of the ore-unloading crane records the lot number, tonnage, and car data on a Teletype Printer. Instantly, this information is reproduced in the yard office in punched tape—starting the automatic writing of waybills by a combination of Teletype page and tape equipment.

The only manual intervention following the transmission of the variable data from the crane is the association of fixed-data tapes by the yard clerk. The entire procedure takes just minutes—so that when the last car is coupled to the train, all waybills, arrival notices, and consignees' copies are ready. Accuracy is improved, too—since mechanization eliminates recopying errors.

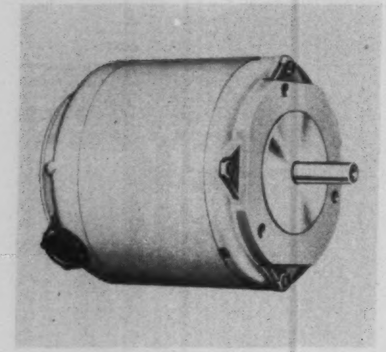
As a by-product of waybill preparation, a master tape is punched automatically, which is used to produce a complete shipping statement. The system also enables the Western Maryland to give customers an extra service to speed their own accounting procedures: advance direct wire transmission of shipping statement data by Teletype equipment or a duplicate of the master tape by mail.

This installation is just one example of how railroads today are using Teletype equipment in new, imaginative ways to trim costs, improve service. This unusual application is made practical by the ruggedness built into Teletype equipment, so that it functions dependably and economically even in the dust-generating environment of ore-loading operations. If you would like information on the new Teletype Model 28 Line, please write to: Teletype Corporation, Dept. 21-L, 4100 Fullerton Avenue, Chicago 39, Illinois.

TELETYPE®
CORPORATION
SUBSIDIARY OF *Western Electric Company* INC.

to 60 psi air actuation, or 15 psi instrument pressure, will handle intermittent actuation pressures up to 125 psi. **Valvair Corp.,** 454 Morgan Ave., Akron 11, Ohio.

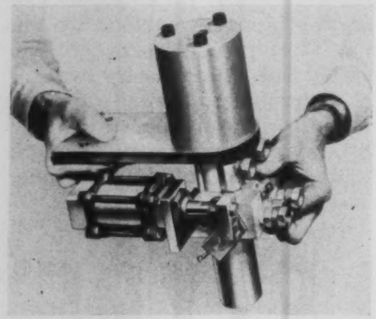
Circle 444 on Page 19



Synchronous Motor

Permanent magnet type synchronous motor can be used on servomechanisms, automatic machines, remote control, and numerical control systems, providing instant starting, stopping, reversing, and stepping. At 60 cycles, the speed accurately remains at 72 rpm without gear reduction. Torque is conservatively rated at 150 oz-in. When the unit is used as a stepping or inching motor, dc impulses are converted into either 200 or 400 precise increments of one revolution of the motor shaft. Rated input for the unit, designated Slo-Syn, is 120 v, 40/70 cycles, 1-phase, and current is 0.3 amp maximum at 60 cycles. **Superior Electric Co.,** Dept. SS, 83 Laurel St., Bristol, Conn.

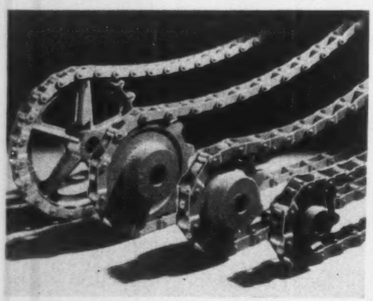
Circle 445 on Page 19



Mixing Head

Suitable for production line molding applications, mixing head is designed for valving, mixing and dispensing polyurethane foams, with throughputs up to 50 lb per minute. Accurately proportioned components are assured throughout the entire foaming cycle because the unit continuously recirculates chemical components when mixing is not taking place. This is accomplished by a rod-type valve which controls two or three material streams with a sharp cut-off for *On-Off* operation. When the valve rod is in *Recirculate* position, material components enter input ports and return to pumping units through recirculate ports. When the snap action of an air cylinder rotates the valve rod to *Mix* position, input materials are diverted to the mixing chamber through removable ports. The mixing impeller can attain speeds up to 6500 rpm for varying throughputs and formulations. The mixing chamber is self-cleaning, eliminating the need for flushing with solvent between shots. **Martin Sweets Co., Inc.,** 114 S. First St., Louisville 2, Ky.

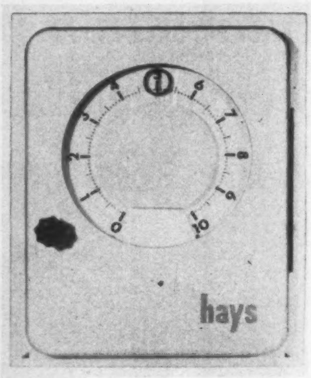
Circle 446 on Page 19



Steel Pintle Chains

Suitable for use on automatic machinery and equipment, steel pintle chains are available in four sizes—662, 667, 667-H, and 672. The chain is designed for applications where the required capacity exceeds those of steel detachable chain, or where there are adverse operating conditions or low maintenance requirements. The chain is formed to close dimensions and uniform pitch from high tensile, heat treated steel. Also available are attachment links which can be used in conveying applications. **Locke Steel Chain Co.,** 1230 Sabine St., Huntington, Ind.

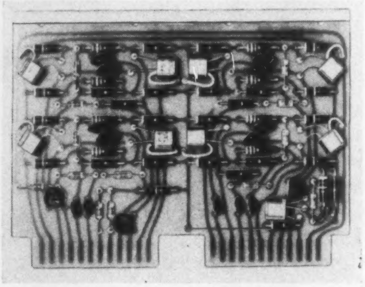
Circle 447 on Page 19



Electronic Indicator

Instrument is capable of indicating values of flow, liquid level, temperature, pressure, position, input motion, and dc mv when incorporating either one of two electronic receiver units—a differential transformer receiver, or a slidewire receiver. Model 721 has a 4.4 second pointer travel over the full scale, with 300 degree indication and total scale length of 12¾ inches. Accessory terminals and adjustments are readily available and the scale can be removed and replaced without recalibration. **Hays Corp.,** Michigan City, Ind.

Circle 448 on Page 19



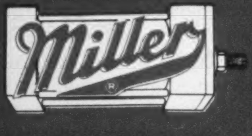
Binary Decade Counter

Transistorized dynamic digital module consists of four transistor flip-flops which can be externally connected as a binary counter, as a binary coded decimal counter, or as other multistage counters that require feedbacks. Power required for Model BD-101 is ±20 v at 20 ma and −90 v at 1 ma. Maximum input rate is 100 kc. **Computer Control Co. Inc.,** 983 Concord St., Framingham, Mass.

Circle 449 on Page 19

Save 27% or more in cost...

NEW

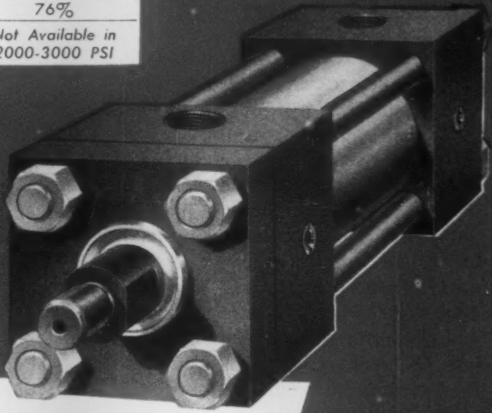


"JOB RATED"

HYDRAULIC CYLINDER LINE

JOB RATED, MODEL " J "			
BORE	SEVERE OPERATING CONDITIONS	MODERATE OPERATING CONDITIONS	YOU SAVE THIS % IN PRICE OVER STANDARD 2000-3000 PSI CYLINDERS
1½"	1500 PSI	2500 PSI	27%
2	1500	2500	27%
2½	1000	1500	28%
3¼	1500	2500	32%
4	1000	1500	35%
5	800	1200	37%
6	800	1200	43%
8	500	800	50%
10	500	800	71%
12	500	800	76%
14	500	800	*Not Available in 2000-3000 PSI*

*with **IDENTICAL** seals, design, and safety factors as the famous Miller "Power-Packed" Model "H" Line for 3000-5000 psi service.*



SEAL FAILURE MEANS CYLINDER FAILURE!

1. *No seal made of synthetic rubber is compatible with even 50% of available, commercial, petroleum base hydraulic fluids.*

MILLER Uses All Teflon* Seals to Eliminate External Oil Leakage because Teflon is impervious to all known hydraulic fluids, even fire-resistant types.

TEFLON SHEF SEAL At Tubing Ends

No blind assembly. Is
Shear-proof
Heat-proof
Extrusion-proof
Fluid-proof

TEFLON Seals On Piston Rod And Bushing

Teflon rod flange seal requires no adjustment. Teflon bushing seal is shearproof. Teflon wiper keeps dirt out.

TEFLON Seals On Ball Check And Adjusting Screw

Non-protruding, self-locking, cushion adjusting screw interchangeable with ball check for easy access.

MILLER Uses Resin-Impregnated Leather Piston Cup Seals because they are compatible with petroleum base fluids and some fire-resistant types. Teflon cups available at small extra cost.

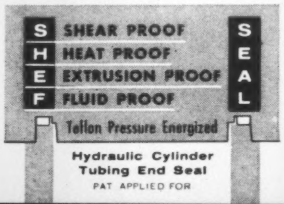
2. *Nicked or scored piston rods cause seal failure*

MILLER Uses Case-Hardened Chrome-Plated Piston Rods because they prevent nicks, scoring and rust.

NOW! . . . You can save MORE with quality Miller "Job-Rated" Cylinders than with cut-price, lesser quality hydraulic cylinders. And the "Job-Rated" Cylinders are also available under the same immediate shipment program as the Power-Packed Line (2 hours if necessary—3 days normal).

---

*du Pont trademark for tetrafluoroethylene resin which withstands temperatures from −100° F. to +500° F. and all hydraulic fluids.



Hydraulic Cylinder Tubing End Seal
PAT APPLIED FOR

OTHER MILLER QUALITY FEATURES

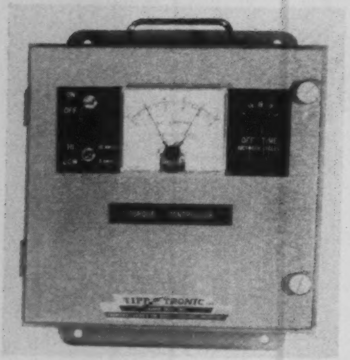
- Rust-Resistant Surfaces
- Interchangeable, Space-Saving Square, 4-Tie-Rod Design
- Precision Honed Barrels

Circle 711 on Page 19

MILLER FLUID POWER
DIVISION OF FLICK-REEDY CORPORATION

7N026 YORK ROAD, BENSENVILLE, ILL.

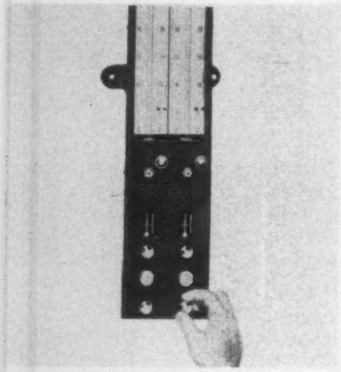
AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS



Torque Controller

Electromechanical unit automatically makes accurate torque force measurements, shutting off power equipment at the optimum point. Some of the applications include: Assuring proper degree of tightening in mechanical run-up in precision nut and bolt assembly; acting as an alarm in automatic production processes in which torque is produced by electric motor drives; and preventing damage to tools or bits in working with hard alloys. It can also control the rolling of tube joints for condensers, heat exchangers, and boilers. The control uses the current drawn by the motor drive as the measurement factor, with automatic shut-off at a point slightly above the normal work load. **TippTronic Inc.**, 510 E. Washington St., Chagrin Falls, Ohio.

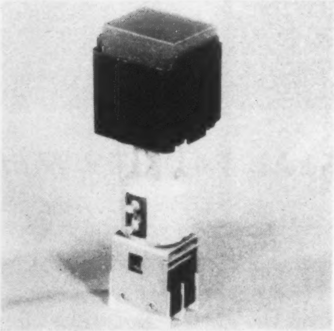
Circle 450 on Page 19



Tank Gage

Line of remote-indicating, continuous-purge tank gages is suitable for gaging all types of liquids from petrochemicals to water, can be used for any size or shape vessel, open or closed, overhead or underground. The gage can be located at transmission distances up to 600 ft from the tank. A purge flow indicator adjusts the trickle purge and shows where the purge rate has been set. For installation, the gage requires only two air line connections for open tanks, and three for closed or pressurized tanks. Cleaning is accomplished through an integral high-pressure purge which is operated through a front-of-panel knob—an internal valve arrangement automatically isolates the gage from the tank line when the high-pressure purge is applied. **Meriam Instrument Co.,** 10820 Madison Ave., Cleveland 2, Ohio.

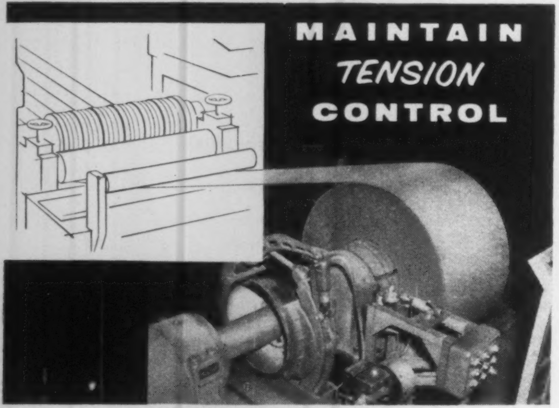
Circle 451 on Page 19



Pushbutton Switch

Designed for use on control panels which require an electrical interlock system (such as used for sequence operation), solenoid-held switch can also be used in remote control applications to monitor the operation of equipment which the switch controls. Unit consists of a pushbutton; an illumination source consisting of two 6 v or 28 v lamps; a double-pole 5 amp switch; and a 28 v solenoid integral with the pushbutton mechanism. The solenoid feature cannot actuate the switch, but is used only to hold the circuit after the switch is actuated. The unit can be wired with or without the solenoid circuit. If the solenoid is not energized, the switch functions as a momentary action control. **Electrosnap Corp.**, 4218 W. Lake St., Chicago 24, Ill.

Circle 452 on Page 19


MAINTAIN
TENSION
CONTROL

**with Wagner
Actuating System and Brakes**

Now, you can keep easily adjustable tension on heavy rolls used in steel slitting operations—in handling paper, and in other similar applications. Wagner Industrial Brakes maintain tension on the rolls and permit emergency machine stops, while Wagner Actuating Systems provide smooth, manually operated control. In the steel slitting machine installation shown above, a regulating valve is used to establish the amount of tension required for various materials and gage thicknesses. A hand operated application valve is used to apply or release the roll tension during set-up and operation.

Your nearby Wagner field engineer will develop detailed specifications to meet your special application. Call him today.

157-3

Wagner Electric Corporation
6430 PLYMOUTH AVE., ST. LOUIS 14, MO.

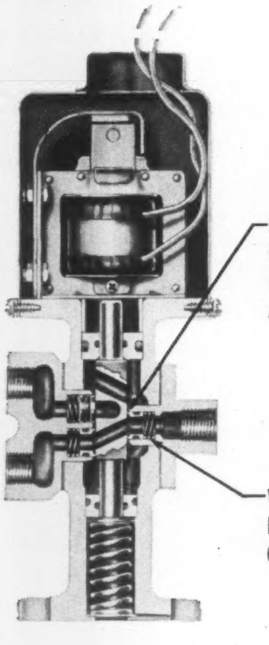
Circle 712 on Page 19

DO YOU SHARE THESE COMMON MISBELIEFS ABOUT SOLENOID AIR VALVES?

"THE SOLENOID IS TO BLAME FOR COIL BURNOUT"
Very seldom, in most cases and particularly with spool valves, sticking valve members create overloads, overheating and coil burnout.

"AIR IS FREE"
Perhaps a little ridiculous, but the way many plants waste it, you would think it was free. Actually, compressed air not properly controlled can be the most costly power medium you use. We have a study on the dollar cost of air leaks that will blow your hat off.

"AIR VALVES ARE ALL ABOUT THE SAME"
When they are new they all work fine. While all other valves start going down-hill with every operation, the sealing qualities of Barksdale Valves are improved through operation.



SHEAR-SEAL VALVE DESIGN PROTECTS THE MOST EXPENSIVE COMPONENT, THE SOLENOID, AGAINST OVERLOADS.

WEAR COMPENSATING FEATURE CONSERVES COSTLY AIR

There is a Barksdale representative in your vicinity who has the facts supporting the above statements.

Send for the bulletin:
"Benefits offered by
Barksdale AIR-SEAL Valves."

CONTROL VALVE DIVISION
barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Barksdale AIR-SEAL* Valves for the nerve centers of production

** The air pressure is the sealing force;*
the higher the pressure,
the tighter the seal.

DIRECT SOLENOID 4-way, 3-way, shut-off and diverter valves

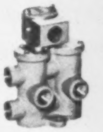
Standard **AC**

Explosion-proof **AC**

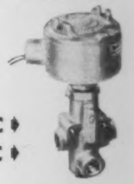
Standard **DC**

Explosion-proof **DC**

SOLENOID-PILOT 4-way and 3-way valves



Standard **AC**
Standard **DC**



Explosion-proof **AC**
Explosion-proof **DC**

MOMENTARY CONTACT solenoid-pilot valves

Single Solenoid

Both types available in standard AC and DC and explosion-proof AC and DC.

Dual Solenoid

MANUAL OVERRIDES for standard solenoid-pilot valves

"L" type manual override

"MK" type manual override

MANUAL and FOOT OPERATED valves

Manual 4-way

Manual shut-off

Foot operated 4-way

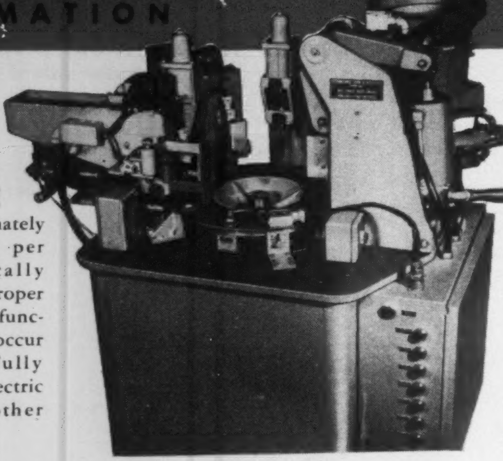
Write for air valve catalog (AV-9) which contains complete data and prices on 562 different valves (not counting voltage variations).

CONTROL VALVE DIVISION
barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

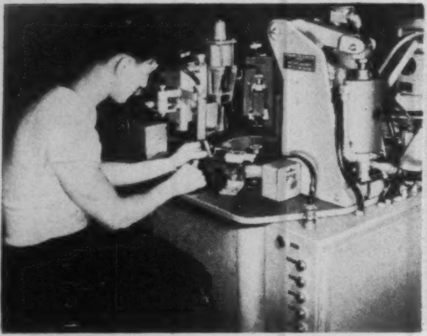
Circle 713 on Page 19

Specify
Standard Tool "building blocks"
AND LOWER THE COST OF AUTOMATION



8-STATION ASSEMBLY MACHINE produces approximately 1500 assemblies per hour, automatically indicates any improper loading or any malfunction which might occur at any station. Fully equipped with electric interlocks and other safety devices.

Rockwell Manufacturing Co., Hopewell Division, now automatically assembles 4 different size double ball check assemblies of two types with a machine designed and built by Standard Tool and Manufacturing Co. incorporating a model ST-A9A indexing unit, Standard Cabinet base, and other precision "building block" components.



OPERATOR MANUALLY LOADS ball check body at **Station 1** (All other operations are completely automatic.) **Station 2** Small ball is loaded. **Station 3** Impact tool forms ball seat. **Station 4** Larger ball is loaded. **Station 5** Impact tool forms larger ball seat. **Station 6** Pin is inserted to hold assembly, or, **Station 7** Top of body is crimped. **Station 8** Completed ball check assembly is ejected.

Changeover from one size or type to another is quickly accomplished and simplicity of design makes it foolproof.

The heart of this Automatic Machine is the ST-A9 indexing unit available in many sizes and types to meet most rapid assembly and manufacturing needs.

Technical Booklets Sent on Request!

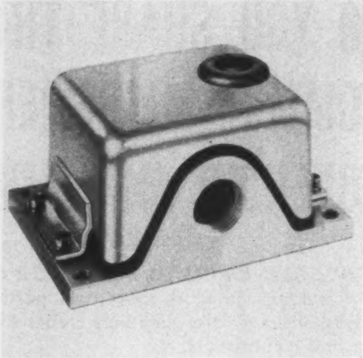
Standard Tool engineers will be pleased to help you in selecting the indexing unit to meet your exact requirements.

Also ask for Standard Tool facilities brochure.

Machinery Division
STANDARD TOOL & MANUFACTURING CO.
Better Products at Lower Costs thru Better Methods
242 LAUREL AVENUE KEARNY, NEW JERSEY

STANDARD TOOL AUTOMATION
Since 1910

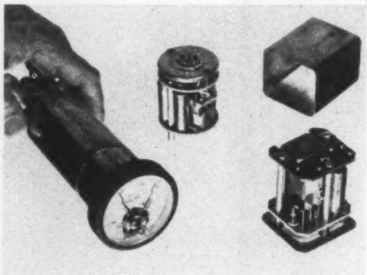
Circle 714 on Page 19



Vibration Detector

Instrument is capable of sensing destructive vibratory forces in rotating and reciprocating machinery. Unit, designated Vibraswitch 66, can sense imbalance or high frequency vibration caused by failing bearings, broken blades, or similar malfunctions. It is designed so that it can be wired to activate an alarm or cause a machine shutdown. Sensitivity of the unit increases with frequency, making it suitable for sensing increases in amplitude at machinery operating speed, or high frequency chatter. **Aeronautical & Instrument Div., Robertshaw-Fulton Controls Co.,** Santa Ana Freeway at Euclid Avenue, Anaheim, Calif.

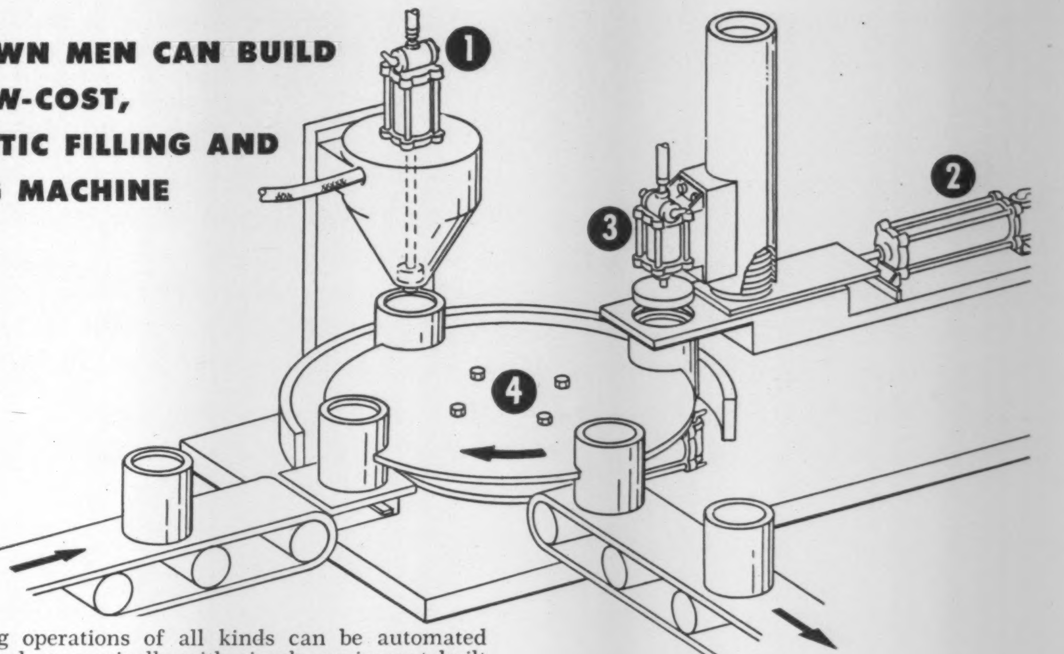
Circle 453 on Page 19



Meter-Relay Packages

Line of miniaturized package controls can measure signals from almost any variable and trigger appropriate control action at adjustable set points. They are available in round or rectangular models. The round models use a 2½-inch meter-relay, have a 2-inch diameter barrel that ranges in length from 2 to 5 inches. The rectangular models use nonindicating meter-relays,

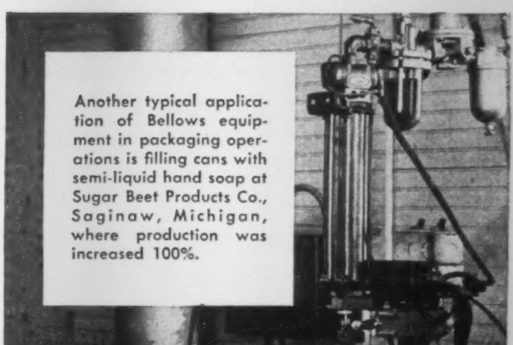
YOUR OWN MEN CAN BUILD THIS LOW-COST, AUTOMATIC FILLING AND CAPPING MACHINE



Packaging operations of all kinds can be automated quickly and economically with simple equipment built around Bellows "Controlled-Air-Power" Devices. This "SPOT-A-MATION IDEA" is typical of the methods used. Originally designed to fill and cap paint cans, it has been adapted to a variety of packaging operations. Bellows equipment has been used in packing and heat sealing plastic bags of sauerkraut, filling and capping glass pill bottles, and packaging granular material in paperboard containers, to cite a few examples.

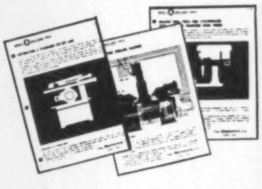
In the sketch above, a belt conveyor feeds empty cans onto a Bellows Rotary Table equipped with a special top (#4), causing it to index through the work stations. After a container has been automatically positioned under the filling hopper, the piston rod of Bellows Air Motor #1 retracts, allowing paint to flow into the can. When a predetermined weight is reached, a limit switch is tripped and the piston rod advances to cut off the flow. At the next work station, Bellows Air Motors #2 and #3, operating alternately, deliver a lid to position and press it onto the can. At the last station, the filled and capped container is removed by a powered belt conveyor. All Bellows Air Motors are synchronized and electrically interlocked to assure proper timing and sequence of operations.

This is just one type of operation which Bellows Work Units can "spot-automate" simply and at low cost. Chances are there are scores of others in your plant. Why not investigate — *today*?



Another typical application of Bellows equipment in packaging operations is filling cans with semi-liquid hand soap at Sugar Beet Products Co., Saginaw, Michigan, where production was increased 100%.

1445-B



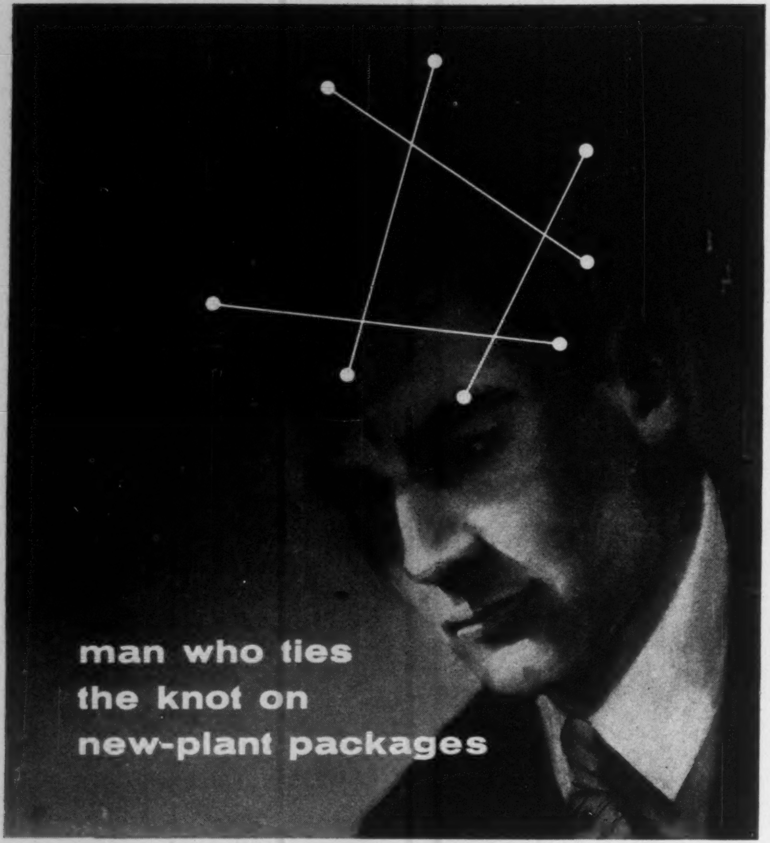
THIS SPOT-A-MATION IDEA FILE IS YOURS ON REQUEST

Contains installation data, wiring diagrams and equipment lists for the filling and capping machine as well as a score of other spot-automation applications of Bellows "Controlled-Air-Power" Devices. Write Dept. AU-1159, The Bellows Co., Akron 9, Ohio.

The Bellows Co.
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)
AKRON 9, OHIO

OTHER INDUSTRIAL DIVISIONS OF IBEC: Sinclair-Collins Valve Co., Valvair, Akron, Ohio • V. D. Anderson Co., Cleveland, Ohio

Circle 715 on Page 19



The conveyor system "wraps up" the plant as a production unit. Designing such a system is a job for a *specialist . . . a specialist called in early.*

"The Man from Logan" offers *complete* conveyor engineering service. One of the industry's most comprehensive lines of equipment enables him to meet every need with the best answer.

Logan's thousands of successful installations cover the half-century through which modern production-line technology has grown. "The Man from Logan" focuses the benefit of all this experience directly on your job. He designs the *one right* conveyor system for your plant.

"The Man from Logan" is stationed nearby for your convenience. He takes over on design and specification and sees your system through to smooth operation. Phone or write today—there is no substitute for "The Man from Logan's" help *early* in new plant plans.

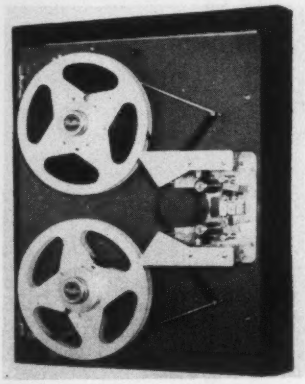
Logan Conveyors

LOGAN CO., 218 CABEL ST., LOUISVILLE 6, KY.

Circle 716 on Page 19

measure 2 by 2¼ by 2¾ inches. Either ac or dc meter-relays can be used. For automatic circuits, sensitivity of meter-relays begins at 200 microamperes. **Assembly Products Inc.**, Chesterland, Ohio.

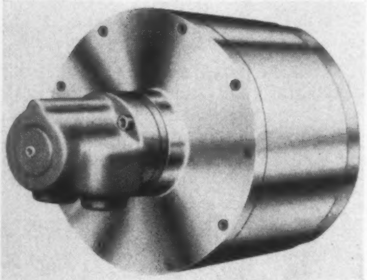
Circle 454 on Page 19



Tape Transport

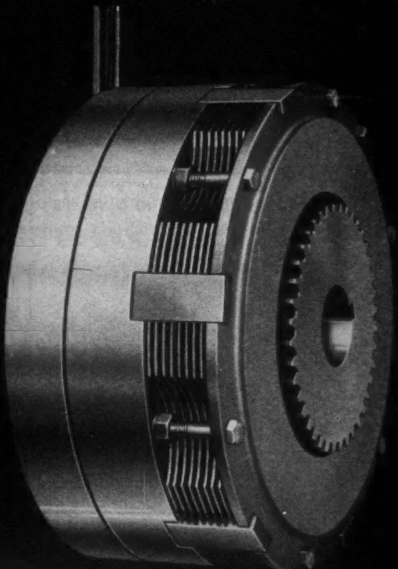
Unit can be used as a coupling to digital communication circuits or as a recorder of long term data occurring at low rates. Model 3280 has transistorized electronics, end of tape sensors, and is adaptable to various reel configurations. It has a speed range of from 10 ips to 0.1 ips. Dual speed combinations are available with standardized ratios. **Potter Instrument Co. Inc.**, Plainview, N. Y.

Circle 455 on Page 19



Rotating Air Cylinder

Designed for use at speeds up to 3600 rpm, rotating air cylinder features a double bearing inlet for longer life at higher speeds and faster operating speeds. It has an inlet packing which automatically adjusts through working pressure. Model RM is available in 3 to 16-



the clutch with the most advantages...

fast cyclic operating rate . . .

large torque capacity in small area . . .

great heat-dissipation capability . . .

high efficiency in wet or dry operation . . .

. . . top performance in all functions: starting, running, torque limiting, cyclic

. . . simple installation

. . . adaptability to automatic controls

. . . get them all with

Fawick SC Magnetics

FAST RESPONSE! — FAWICK Magnetics respond instantly to controls — have provided rates as fast as 40 cycles per second! They respond to limit switches, relays, punched tape or any other electric or electronic control.

LARGE TORQUE CAPACITY — Excellent torque-vs.-size ratio — example, 2100 inch-pounds running torque with a 5½" diameter clutch operating dry!

FAST HEAT DISSIPATION — Exceptional heat dissipation characteristics permit faster cycling under heavier loads over longer periods of time than other clutches of comparable size.

"WET" OR "DRY" OPERATION—FAWICK friction discs are designed for operation either in oil or dry . . . in dry operation they are not harmed by unintentional presence of oil.

SUPERIOR CLUTCH FUNCTION — Consistent performance, cycle after cycle — plus direct relationship between coil voltage and torque capacity — provide extreme accuracy and versatility.

SIMPLE INSTALLATION — FAWICK Magnetics are supplied completely assembled — bores and keyways for clutch body and gear are made to required specifications.

For detailed information write today for bulletin M-102.

FAWICK AIRFLEX DIVISION
FAWICK CORPORATION
9919 CLINTON ROAD • CLEVELAND 11, OHIO
Fawick Canada, Ltd., 60 Front St., West, Toronto, Ont., Canada

FAWICK
MAGNETIC

FAWICK MAGNETICS — WORLD'S FINEST ELECTRIC CLUTCHES

Circle 717 on Page 19

BECKETT HI-CYCLIC

the valve name you need to know to fill any directional control application!

Beckett Hi-Cyclic Valves are sealed by **precision,** metal-to-metal fit. There are no working packings. Only the brass valve body and stainless steel spool are in contact with the media. These valves give **longest service life!**

Seven spool types meet all requirements. Special spools to specifications. Short spool stroke gives extremely **fast** reaction.

Practically every Beckett Hi-Cyclic Valve (more than 150 models) is a variation based upon a compact, basic valve body. By adding suitable actuators, the basic valve is adapted to almost any given situation. Many actuator assemblies can be combined or interchanged, thus making the line of Hi-Cyclic Valves almost **universal** in range of application.

"SPECIALS" WELCOMED!

If a standard Hi-Cyclic Valve will not fulfill your needs, we welcome the opportunity to economically design and manufacture the valve to your most exacting specifications.

Write for complete valve catalog or detailed information on Hi-Cyclic Valves to meet your requirements.

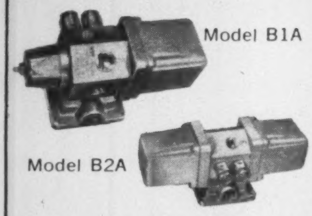
NFPA NATIONAL FLUID POWER ASSOCIATION MEMBER

DISTRIBUTORS IN MAJOR CITIES COAST-TO-COAST AND CANADA

BECKETT-HARCUM COMPANY

983 W. Locust St., Wilmington, Ohio

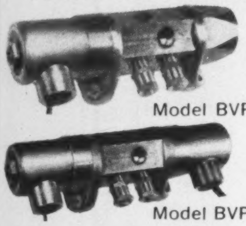
DIRECT-ACTING SOLENOID VALVES



Model B1A

Model B2A

SOLENOID PILOTED VALVES

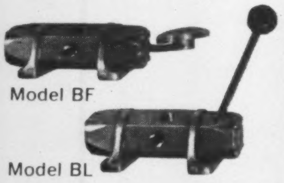


Model BVP1

Model BVP2

THE COMPLETE LINE OF PRECISION AIR AND HYDRAULIC CONTROL VALVES. N.P.T. SIZES 1/8" TO 1"

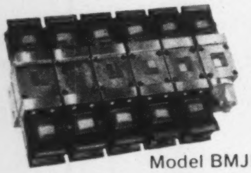
MANUAL, MECHANICAL AND PILOT ACTUATED VALVES



Model BF

Model BL

SINGLE SUBPLATE OR MANIFOLD MOUNTING VALVES (Including miniature valves that mount on 2" centers.)



Model BMJE

inch bore sizes, making it adaptable to serve as an actuator for chucks, collets, and other rotating holding devices. For special requirements, draw bars for linking cylinders to chucks can be furnished. Housings and covers are made of aluminum alloy to keep weight low. **S-P Mfg. Corp.,** 30201 Aurora Rd., Solon, Ohio.

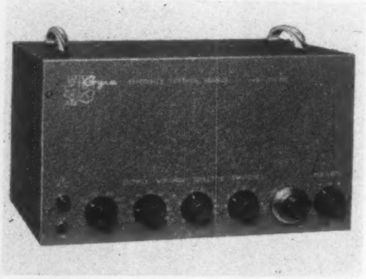
Circle 456 on Page 19

SERVO AMPLIFIER
MODEL 130 SERIAL
CONTROL TECHNOLOGY CO.
NEW YORK, N. Y.

Servo Amplifier

Transistorized servo amplifier will drive either 3.5 w or 6 w servomotors from low level 400 cps signals. Because of its isolated input and an input impedance minimum of 100 k, it is suitable for computing applications. Maximum gain for Model 130 is 2000 and gain stability is 3 db over temperature range. Amplifier operates on 28 v dc with an internal limiting against dc line transients. **Control Technology Co.,** 1186 Broadway, New York 1, N. Y.

Circle 457 on Page 19



Voltage Reference

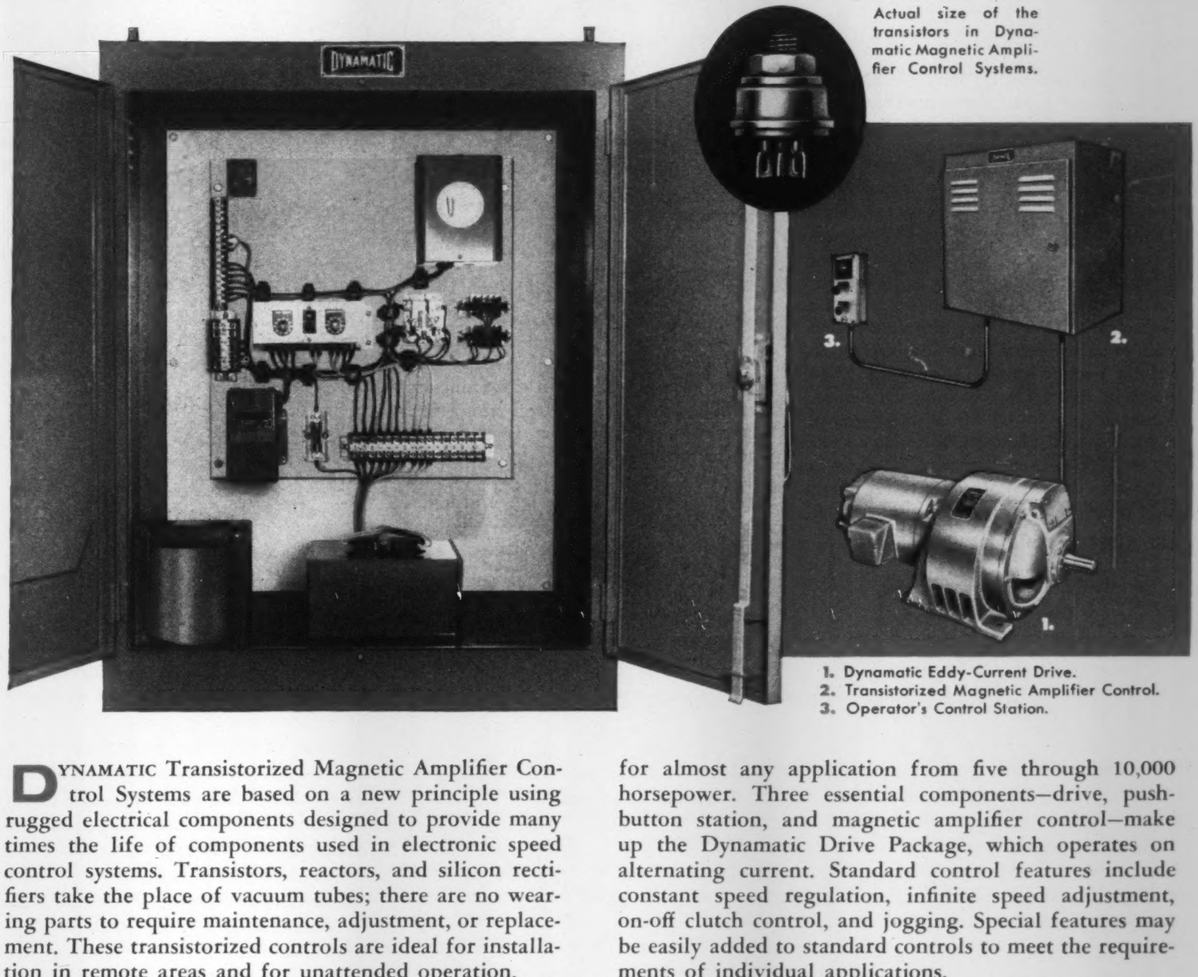
Instrument can provide precision regulation in production conditions, continuously variable from 0 to 600 v in steps of 0.0001 v. It is used in conjunction with a company elec-

NEW RELIABILITY!

DYNAMATIC®

MAGNETIC AMPLIFIER
(TRANSISTORIZED)
CONTROL SYSTEMS

for Eddy-Current Rotating Equipment



Actual size of the transistors in Dynamatic Magnetic Amplifier Control Systems.

1. Dynamatic Eddy-Current Drive.
2. Transistorized Magnetic Amplifier Control.
3. Operator's Control Station.

DYNAMATIC Transistorized Magnetic Amplifier Control Systems are based on a new principle using rugged electrical components designed to provide many times the life of components used in electronic speed control systems. Transistors, reactors, and silicon rectifiers take the place of vacuum tubes; there are no wearing parts to require maintenance, adjustment, or replacement. These transistorized controls are ideal for installation in remote areas and for unattended operation.

Used in combination with Dynamatic Eddy-Current Drives, Transistorized Magnetic Amplifier Controls provide infinite speed adjustment and accurate control for almost any application from five through 10,000 horsepower. Three essential components—drive, pushbutton station, and magnetic amplifier control—make up the Dynamatic Drive Package, which operates on alternating current. Standard control features include constant speed regulation, infinite speed adjustment, on-off clutch control, and jogging. Special features may be easily added to standard controls to meet the requirements of individual applications.

Dynamatic Transistorized Magnetic Amplifier Control Systems provide a high degree of accuracy and versatility—and are practically maintenance-free.

EATON® *Send for New Illustrated Bulletin Describing Circuitry, Construction, and Operation.*

EATON
DYNAMATIC DIVISION
MANUFACTURING COMPANY
3307 FOURTEENTH AVENUE • KENOSHA, WISCONSIN

Circle 719 on Page 19

DESIGN CONSIDERATIONS

Backlash in Indexing Mechanisms for High Production Machinery

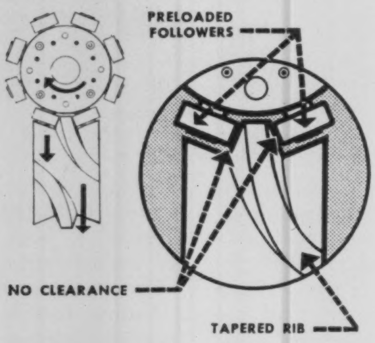
Backlash in indexing results in impact or shock loads that affect the efficiency of a machine and the quality of its product. Most indexing mechanisms have inherent characteristics that cause backlash and poor dynamic conditions and prevent the machine designer from taking full advantage of modern automatic feeds, tooling and methods that contribute so much to production economy.

Of the three principal indexing mechanisms, only one offers zero backlash and years of maintenance-free operation:

FERGUSON DRIVE

Continuously rotating cam includes a tapered rib, along which two preloaded bearing followers roll with no clearance between them and the rib. When the drive is in the rest, or dwell, position a straight portion of the rib locks the followers with *zero backlash* and an indexing accuracy of .001″. Wear of the hardened cam is infinitesimal since it is subject to rolling friction only (many cams have been in use for more than 25 years). Followers are rated for a minimum of 8,000 hours precision operation at speeds up to 2,000 indexes a minute. If followers wear after this time, they can be replaced, thus renewing the drive for a like period.

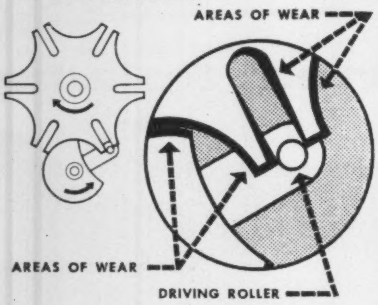
FIG. 1 FERGUSON DRIVE



GENEVA DRIVE

A geneva drive consists of a slotted wheel and a driver with a driving roller. Indexing occurs when the roller crashes into the slot, causing the wheel to move one increment. There must be clearance in the slot to allow passage of the roller. With clearance there must also be backlash. Impact loading, resulting from the inherent backlash, causes the slots to wear quickly and the backlash becomes progressively more severe. Operating speeds must be limited to contain the dynamic forces generated by backlash, even then, genevas require replacement with great frequency and downtime for maintenance is a major problem.

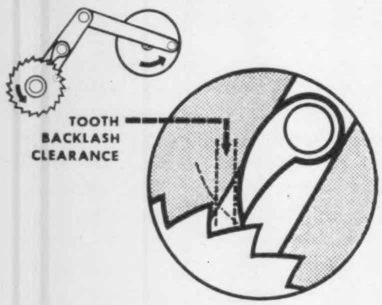
FIG. 2 GENEVA DRIVE



RATCHET & CRANK

Tooth clearance backlash causes the pawl to strike the ratchet teeth with considerable impact when indexing begins and vibratory forces are extreme. After mid stroke, the arm stops the pawl gradually but the wheel must be stopped by frictional braking or by positive means. Friction brakes allow over-travel and inaccuracy of index. They wear quickly and require excess downtime for maintenance. Because positive stopping is instantaneous, impact and rebound action of the wheel is tremendous. Neither method of stopping is satisfactory from the standpoint of low maintenance requirements or controlled dynamic conditions. Sustained high speed production is virtually impossible.

FIG. 3 RATCHET & CRANK



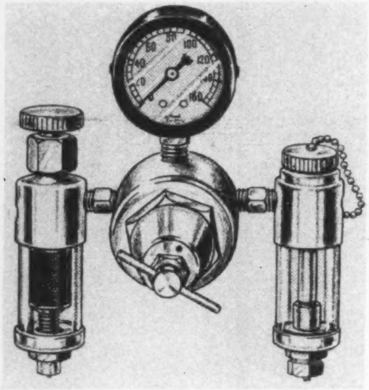
• SEND FOR CATALOG

Zero backlash is only one inherent advantage of the Ferguson Drive. Others are explained in an easy-to-use catalog containing load ratings and dimensions of many standard units, drawings and installation photos. There is a copy for every design engineer . . . Write **FERGUSON MACHINE CORPORATION, 7818 MAPLEWOOD INDUSTRIAL COURT, ST. LOUIS 17, MO.**

Circle 720 on Page 19

trometer to null current. Line voltage variations between 90 and 135 v will not affect the unit more than 1 part in 10^5. Temperature fluctuations of 10 F have minimum effect on stability. Model RVS-100 (shown) has a long-term drift stability which allows regulation of 90-135 v, 60 cps, single phase to within ±1 part in 10,000 per day. Voltages are set by four output switches controlling 100, 10, 1, and 0.1 v. A fine adjustment controls settings in hundreds of microvolts. Instrument is available for rack or cabinet mounting. **Gyra Electronics Corp.**, 518 N. Spring Ave., La-Grange Park, Ill.

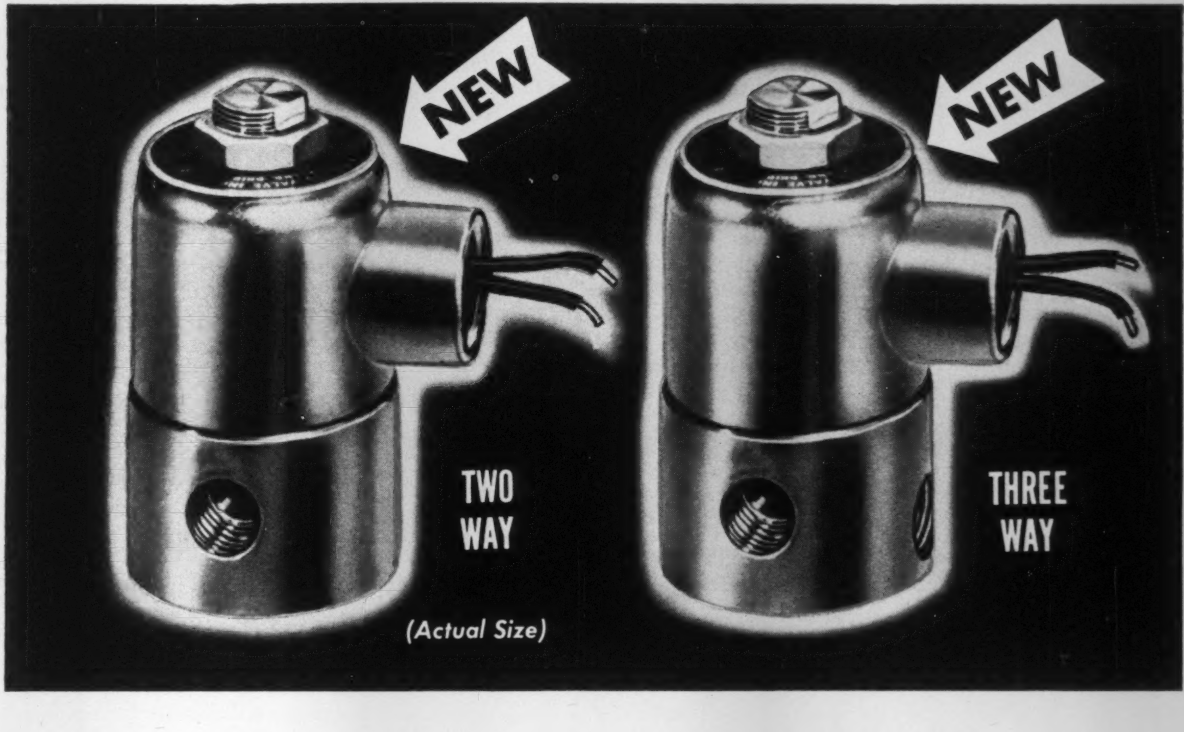
Circle 458 on Page 19



Air Line Control

Combination air line unit filters air, removes moisture, supplies an oil mist, and regulates air pressure to a desired value. The air filter is capable of handling capacities up to 7 cfm. It is equipped with a 40 mu filter element that is easily cleaned. Condensate is drained from the transparent reservoir through a small valve on the bottom. The air line oiler functions automatically, furnishing an oil mist proportional to the air used. The oil delivery is regulated on the bottom of the oiler. The regulator reduces air pressure to any selected value and automatically retains this secondary pressure. Flow is unrestricted with a minimum pressure drop. The pressure gage can be used on maximum air pressures of 150 psi and maximum temperatures of 150 F. **Oil-Rite Corp.**, 2312 Waldo Blvd., Manitowoc, Wis.

Circle 459 on Page 19

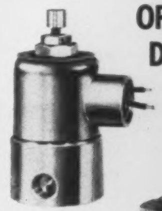


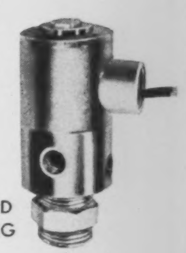
NEW SOLENOID VALVES *by* Airmatic

These corrosion-proof valves have only one internal moving part and a completely protected solenoid coil. The coil is fully sealed from air, oil, gas and water . . . and will not overheat on continuous duty. Coils for continuous or intermittent duty, a-c or d-c, are interchangeable.

Life expectancy is many millions of cycles and by renewing the one-piece valve plunger, many millions more can be expected. The plunger can be replaced without disturbing rigid piping.

OPTIONAL DESIGNS


MANUAL OVER-RIDE


MANIFOLD MOUNTING

DISTRIBUTORSHIPS FOR THESE NEW VALVES ARE AVAILABLE

	SPECIFICATIONS	
	TWO-WAY	**THREE-WAY**
CATALOG NO.	91011	91011
PRESSURE RANGE	1/16″ ORIFICE: 0-500 PSI 3/16″ ORIFICE: 0- 70 PSI	1/8″ ORIFICE: 0-300 PSI 3/16″ ORIFICE: 0-100 PSI
ORIFICES	1/16″ THROUGH 3/16″	1/8″ AND 3/16″
VOLTAGE	MOST A-C AND D-C	MOST A-C AND D-C
DUTY	CONTINUOUS	CONTINUOUS
POWER CONSUMPTION	10 - 20 WATTS	10 - 20 WATTS
HEAT RISE	WITHIN UL LIMITS	WITHIN UL LIMITS

ASK FOR CATALOG

Airmatic Valve, Inc.

All valve deliveries are made from stock.

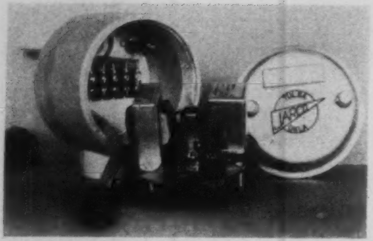
AIRMATIC VALVE, Inc.

7313 Associate Avenue • Cleveland 9, Ohio

EVERYTHING UNDER CONTROL

Phone: WOodbine 1-5320 • WESTERN UNION: Airmatic Valve, Inc., FAX, Cleveland, Ohio

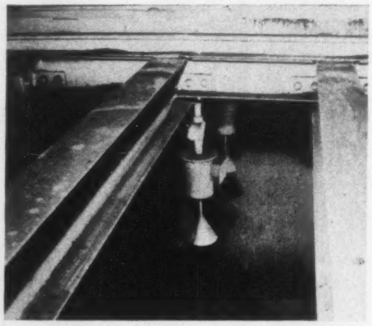
Circle 721 on Page 19



Water Level Control

Designed for automatic water drawoff in hydrocarbon storage tanks, device can also be used in dielectric constant liquids such as acids or alkalies. The conductivity of the water being measured has almost no effect on the operation of the liquid level control. Conductivities from a small part of a micromho to several million micromhos will cause the same snap action of this level control with no change in adjustment. The control can be used in corrosive atmospheres as the control relay is hermetically sealed in a metal can and plugs into the chassis. Input power is 117 v ac, to 7 w. Output relay is DPDT rated 5 amp ac. **Jarco Services Inc.**, 415 S. Kenosha, Tulsa, Okla.

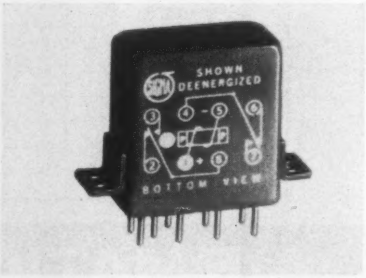
Circle 460 on Page 19



Bin Level Control

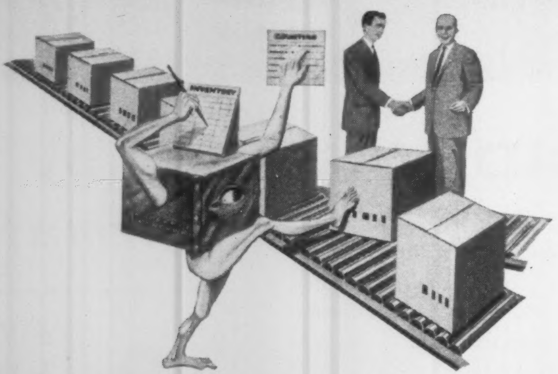
Self contained bin level control switch can automatically control the level of material in bins. Three types of controls are available—normal duty for light to medium weight granular material; explosion-proof for use in hazardous locations; and heavy duty for heavy, lumpy materials. The control is equipped with a pendant float which operates a sensitive enclosed switch. In operation, it is mounted in a bin or tank and as the material level rises or falls, the control will stop or start feed conveyors or elevators. It can be connected to operate warning lights or horns. Designed to be connected for a normally-closed circuit, the control can also be connected for normally-open circuits. **Stephens-Adamson Mfg. Co.**, Ridgeway Ave., Aurora, Ill.

Circle 461 on Page 19



Subminiature Relay

Subminiature polarized relay provides 2-position, magnetically biased operation at a standard sensitivity


NEW AUTOMATIC HANDLING OF PACKAGED GOODS

Reads printed codes automatically.

SELECTIVE automatic counting and sorting of MIXED products are now possible with Atronics 400 Series transistorized carton selector equipment. Your materials handling can be thoroughly modernized at low cost.

Make your operation a model for the industry . . . a point of company pride . . . and a new source of company profit. Write today for details.

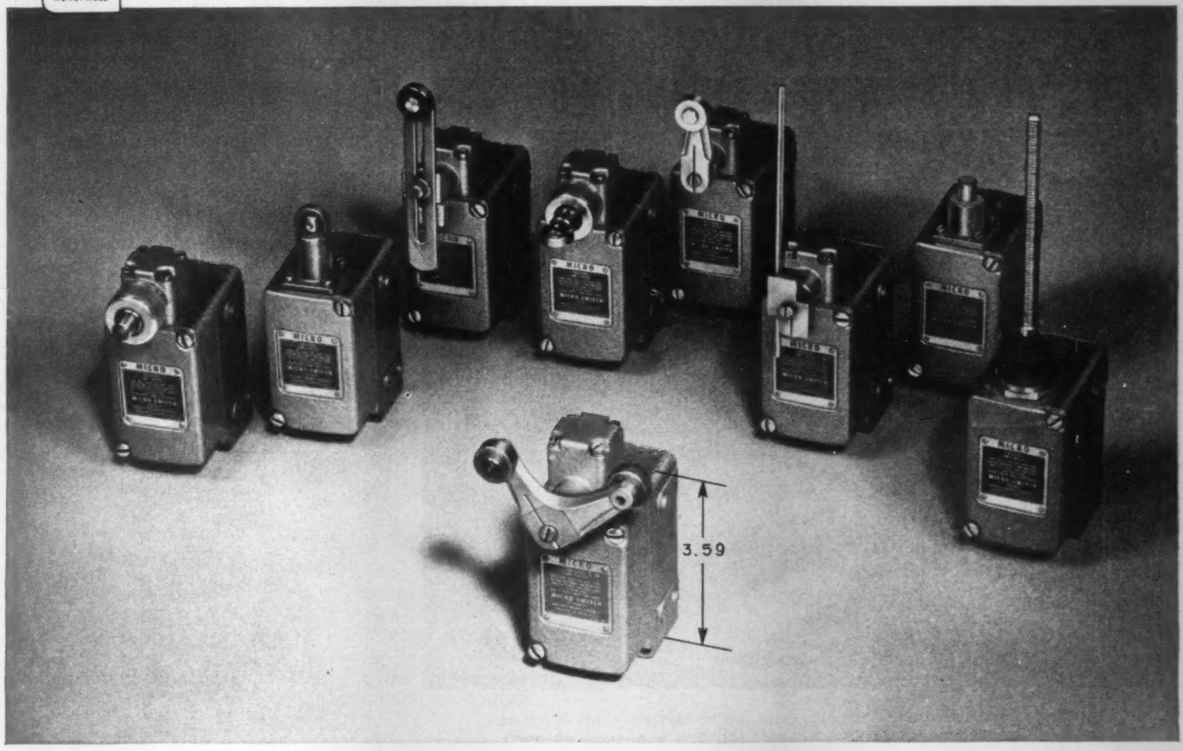
901 R

ATRONIC PRODUCTS, INC.
BALA-CYNWYD, PENNA.
AN AFFILIATE OF GENERAL ATRONICS CORPORATION

ATRONICS

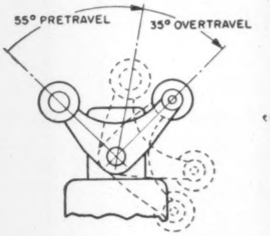
Circle 722 on Page 19

MICRO SWITCH Precision Switches



New "Plug-in Limit" switch . . . now there are nine

Here is a new "Plug-in Limit" switch with yoke actuator—the ninth in the famous "200LS" Series. The yoke is adjustable to any position on the shaft through 360°, and the operating head mounts in any of four positions. The new 206LS1 is a maintained contact switch.



"200LS" Series switches have found ready acceptance as limit switches for control of lathe carriages, grinders, table feeds, drilling and tapping equipment, automated machinery, etc.

"Plug-in Limit" switches plug into the terminal enclosure like a radio tube and can be replaced in seconds, practically eliminating costly downtime. They are rugged, reliable, and completely sealed against oil, water, dirt and dust.

Contact arrangement is two-circuit double-throw.

Electrical rating is: 10 amps, 120, 240, 480 vac; ½ hp, 120 vac; 1 hp, 240 vac; 0.8 amp, 115 vdc; 0.4 amp, 230 vdc; 0.1 amp, 550 vdc. Pilot duty rating is 600 vac max. Meets NEMA Industrial Control standards.

PULL OUT

PLUG IN

For details of the "200LS" Series, write or call the MICRO SWITCH *branch office or authorized distributor near you. Consult the Yellow Pages.*

MICRO SWITCH . . . FREEPORT, ILLINOIS
A division of Honeywell
In Canada: Honeywell Controls Limited, Toronto 17, Ontario

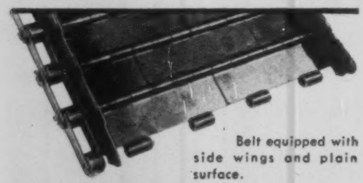
Honeywell
MICRO SWITCH Precision Switches

MAY-FRAN HINGED-STEEL CONVEYOR SYSTEM SOLVES ANOTHER PARTS AND SCRAP HANDLING PROBLEM

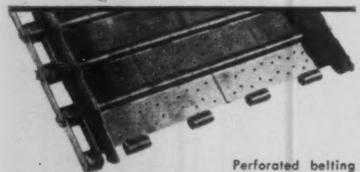
54-500-144-90

PHOTO: In this automotive plant, two May-Fran hinged-steel conveyors are utilized to speed production and clear scrap from the working area. Scrap is taken from under floor area and carried to chute where it crosses belt carrying semi-finished parts. Combination chute and storage unit discharges load only when tote box is in position.

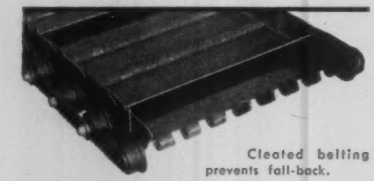
8714-MF



Belt equipped with side wings and plain surface.



Perforated belting to permit drainage.



Cleated belting prevents fall-back.

Pre-engineered for maintenance-free operation, maximum economy and long service life, the May-Fran hinged-steel belting has been developed especially for handling all types of heavy and rough materials. This belting is available in any width or length to meet individual job requirements. CUSTOMIZED conveyors can be supplied from stocked component parts. Installations can be made below floor level, flush with floor or above floor level.

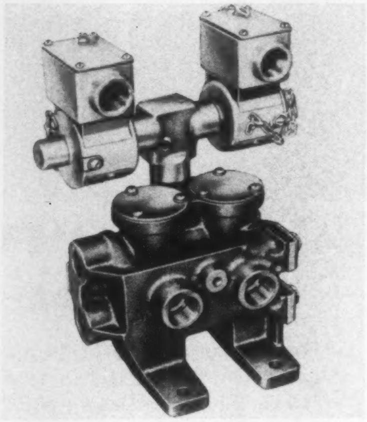
Write today for Catalog MF-100

MAY-FRAN
ENGINEERING, INC.
1761 Clarkstone Rd. • Cleveland 12, Ohio

Circle 724 on Page 19

of 200 milliwatts within a temperature range of −65 to +125 C. It has a vibration resistance to 5000 cycles at 30 g. Shock and constant acceleration up to 100 g will not cause damage or open the contacts. The relay armature is transferred from a normally-closed position to the open position by a coil signal of the proper polarity and magnitude and is held in place by a permanent magnet. When the signal is removed, the armature returns to the normally-closed position. Operating time ranges from 2 to 20 milliseconds, depending on overdrive. Contact rating for this relay is 2 amp for silver contacts; 0.5 amp for gold alloy contacts. **Sigma Instruments Inc.**, 170 Pearl St., So. Braintree 85, Mass.

Circle 462 on Page 19

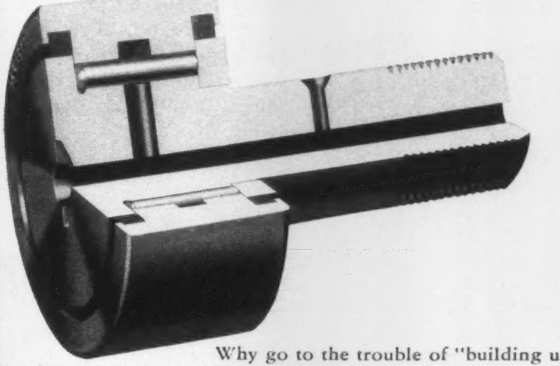


Solenoid Air Valve

Momentary contact, 4-way valve is available as a single solenoid or dual solenoid unit. Current is required only for the instant it takes the valve to change position. The valve remains in that position with the power off. In operation, when the solenoid is actuated by electric impulse, the solenoid plunger moves down, actuating the pilot valve which in turn operates the main valve. The momentary contact device then latches the pilot valve in this position after the power is cut off. When an electric impulse energizes the solenoid again, the solenoid plunger unlatches the contact device and allows the pilot valve and main valve members to revert to the original normal position. The solenoid is de-energized,

AUTOMATION TIPS
by McGill

CAMROL® bearings...save the cost–and inconvenience–of improvised followers in automated machinery

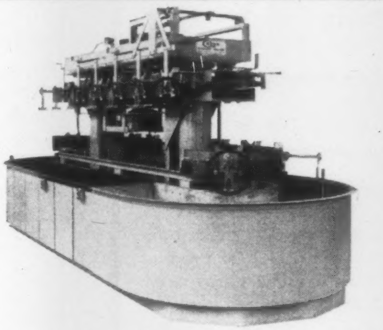


Why go to the trouble of "building up" special roller followers when CAMROL cam followers can provide so many construction advantages in a standard bearing? Select the proper size from roller diameters of ½" to 4" in either the CF (with stud) or CYR (for shaft mounting). It saves time and money when applying roller followers to cam follower, track, guide and support roller applications.

The McGill construction is backed by over 25 years experience with thousands of applications. Selected steel, tested design, special heat treatment and simplified lubrication insures the dependability of CAMROL — the original roller bearing cam follower.

For protected performance, SCF Series Sealed Camrol Bearings provide the added advantages of better lubrication retention and sealing against dust, dirt and other contamination. Frequent relubrication can be avoided.

AUTOMATIC PLATING MACHINES USE CAMROL BEARINGS

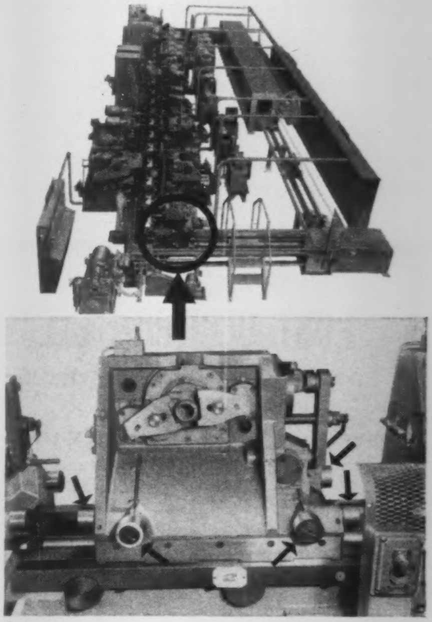


CROWN RHEOSTAT AND SUPPLY COMPANY uses up to 200 Sealed CAMROL cam followers as guide and support rollers in the travel and transfer mechanisms of their cleaning, plating and drying machines. The machine shown here is a CROWN Type "D" Fully Automatic Plating Machine. The CAMROL bearings assure precision action, reduced friction and minimum maintenance. Built-in seals protect the bearings from cleaning and plating solutions.

FOR COMPLETE ENGINEERING DATA ON McGILL PRECISION NEEDLE ROLLER BEARINGS, SEND FOR BEARING CATALOG NO. 52-A

FIXTURES ROLL FREE—and accurately on Sealed CAMROL bearings

Production parts are drilled, milled, bored and tapped in automated systems engineered and built by the BUHR MACHINE TOOL COMPANY. The moving fixtures which hold parts being machined are guided and carried on McGill sealed CAMROL bearings as shown in the close-up below.



By reducing the starting and running friction to an absolute minimum, the CAMROL bearings have made horsepower requirement reductions possible in these systems. Ample load capacity, high resistance to shock loads and integral seals which retain lubrication and keep out contamination have held maintenance down. In the system pictured, 8 SCF-3 CAMROL bearings accurately guide and support each of 28 fixtures. Performance is reported excellent.

engineered electrical products

McGILL®

precision needle roller bearings

SEND FOR CATALOG No. 52-A

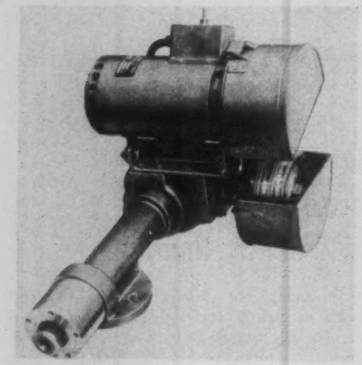
MULTIROL — GUIDEROL — CAMROL

McGILL MANUFACTURING COMPANY, INC., BEARING DIV., 401 N. LAFAYETTE ST., VALPARAISO, INDIANA

Circle 725 on Page 19

and the valve remains in this position until the next actuation. **Barksdale Valves,** 5125 Alcoa Ave., Los Angeles 58, Calif.

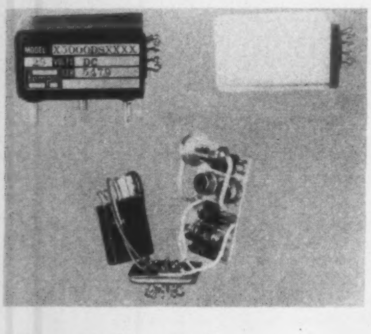
Circle 463 on Page 19



Drill Head

Device can be mounted in a fixed position for drilling, tapping, milling, boring, and honing operations, or it can be used as a conversion unit to be mounted on lathes, planers, and mills. Model 10324 has a speed range from 300 to 3000 rpm through 6 individual V-belt sheaves—3 on the motor and 3 on the spindle gear drive. Optional equipment available is an abrasive belt idler for grinding and polishing operations, a guard for the belt idler, and an air or hydraulic operated slide. Unit is driven by a 1½ hp 60 cycle motor available for 208, 240, or 440 v operation. **Larmet Co.,** 108 Wiggs St., P. O. Box 193, Griffith, Ind.

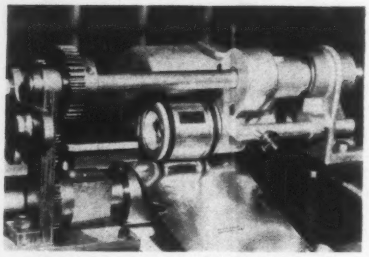
Circle 464 on Page 19



Time Delay Relay

Subminiature time delay relay has a 20 to 1 adjustment range, is suitable for use in electronic systems. Feature of the unit is the transistor timing module which has no moving parts. Six basic units are available with overlapping time delay ranges of 0.050 to 1 second, 0.150 to 3 seconds, 0.750 to 15 seconds, 3 to 60 seconds, 9 to 180 seconds, and 15 to 300 seconds. Relay has an accuracy rating of 5 or 10 per cent of nominal time delay, will operate with input voltage variations from 18 to 31 v dc, temperatures from −55 to +125 C, vibration to 20 g's, 2000 cps, shock to 50 g's, 11 milliseconds, and acceleration to 20 g's. **Tempo Instrument Inc.,** P. O. Box 338, Hicksville, N. Y.

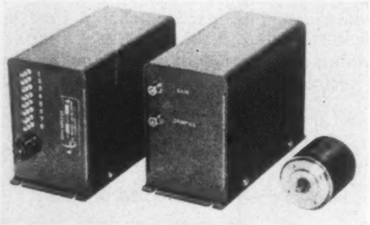
Circle 465 on Page 19



Miniature Printer

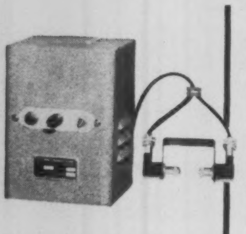
Unit, designated Electra-Printa, can imprint hard-to-print coated materials such as foil, glassine, cellophane, and polyethylene. It will also imprint registered marks on various cutoff lengths without requiring a change of cylinders. Model 1006-A is actuated on a 110 v, 60 cycle electrical current and is operated by an automatic solenoid. **Bell-Mark Corp.,** 92 South 6th St., Newark 7, N. J.

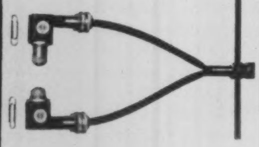
Circle 466 on Page 19



Amplifier & Servo

Transistorized, 60 cps servo amplifier can drive a 9 watt servo-





POST DECITRON ELECTRONIC PRODUCTS
Photoelectronic Controls

Model K-1 with Miniature Photohead
This is a general purpose photoelectric control whereby the interruption of a light beam in the photohead closes a relay which can be used to activate an external circuit.

Model K-3
The K-3 control differs from the K-1 in that the output relay will not energize for each interruption of the light beam, but only if interruptions cease. Can be used to detect "flow" stoppage.

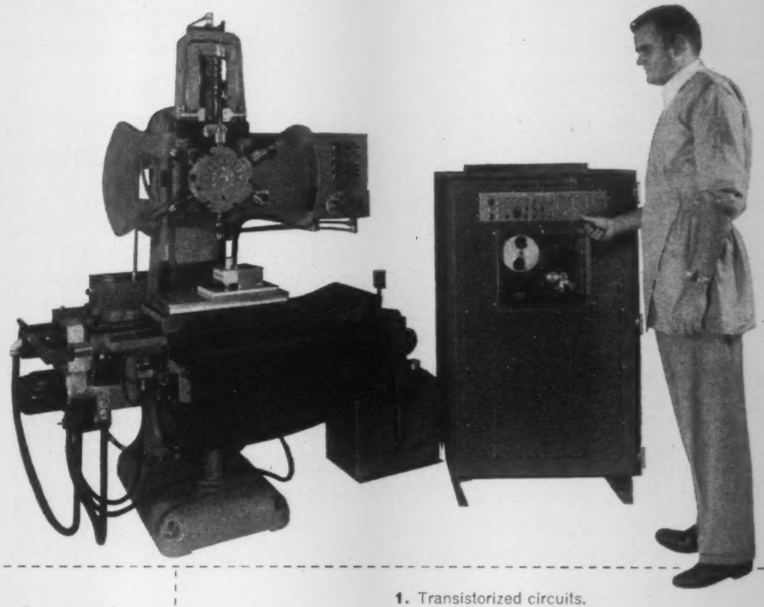
Model H-21-C
The compact, long life, *miniature* photohead . . . ideal for mounting in limited space. May be furnished with alignment brackets to insure proper relation of light source and receiver.

Decitron

ELECTRONIC PRODUCTS DIVISION
Post Machinery Co. | 159 Elliott St., Beverly, Mass.

Circle 726 on Page 19

NEW! HUGHES 2-AXIS MACHINE TOOL CONTROL



The new Hughes Machine Tool Control provides you with automatic positioning of a two-axis table plus third axis feed control if desired. Designed for use in drilling, boring, turning, riveting, spot welding, punching, eyelet inserting and other similar operations, the Hughes Control offers you significant tooling and labor savings. It is easily adaptable to new machines or for retrofit.

advantages

1. Simplification of tooling reduces lead time.
2. Precision positioning eliminates expensive tooling.
3. Handling is reduced between operations.
4. High-speed operation reduces the number of machines required.
5. Scrap due to operator errors is reduced.
6. Very large savings are realized in re-run of any given parts order.
7. Eliminates large inventories.
8. Rework of tooling after design changes is replaced by simple modification of machine tape.
9. The new operator produces as much as the experienced operator.
10. Cost estimating is more precise.
11. The inspection burden is greatly eased. All parts are identical.
12. Planning and scheduling is greatly simplified. Many more operations can economically be performed with one machine and one setup.
13. Tape control means the machine delivers high precision work at the same cost as low precision work. Tight tolerances at no extra cost.

advanced features of the new Hughes Products 2-axis machine tool control

1. Transistorized circuits.
2. Mercury-wetted relays eliminate "chatter."
3. Positioning accuracy is ± 0.0005", non-cumulative. Repeatable accuracy: ± 0.0002". Input resolution: 0.001".
4. Compact cabinet occupies minimum of valuable floor space.
5. Third axis of control easily added at nominal cost.
6. Electronic position transducer insures continuing accuracy and reliability.
7. Digital system assures positive, accurate, high-speed positioning at 180" per minute.
8. Modular construction of plug-in units cuts down-time. Spare unit simply inserted for continuous production.
9. Standard 1", 8-channel Mylar tape used in system.
10. Optical tape reader for precise, high-speed information input.
11. Tape is prepared on Hughes Products unit which is simple to operate and low in cost.

other specifications

Travel	Unlimited, except that the maximum movement per block of tape is 39.999 inches.
Axis Control	Two axes simultaneously.
Drive System	"Creep Traverse Drive Unit" to be attached to preloaded ball bearing leadscrew.
Tape	1 inch, eight channel, opaque, perforated tape.
Tape Reading Time	Less than one second during feed axis movements. Does not add to machining cycle.
Drive System Power	1/4 hp (higher power in special unit).
Resolution	0.001 inch.
Auxiliary Functions	24 bits of information available—programmable as six binary coded decimal digits.
Operation Modes	1) Automatic. 2) Set-up (semi-automatic for tape and program checking). 3) Manual.
Power Requirements	110 volt, single phase. Control plus drive motors require less than 10 amps.

For further information on the Hughes Machine Tool Control...and its application to your specific needs...please write or wire: HUGHES PRODUCTS, Industrial Systems Division, International Airport Station, Los Angeles 45, California.
For export information, write: Hughes International, Culver City, California.

Creating a
new world with
ELECTRONICS

HUGHES PRODUCTS

© 1959, HUGHES AIRCRAFT COMPANY

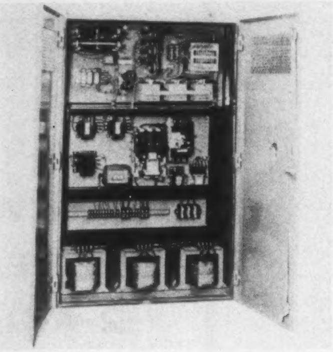
SEMICONDUCTOR DEVICES • STORAGE TUBES AND DEVICES • MICROWAVE TUBES • VACUUM TUBES AND COMPONENTS • CRYSTAL FILTERS • MEMO-SCOPE® OSCILLOSCOPES • INDUSTRIAL CONTROL SYSTEMS

Circle 727 on Page 19

motor from synchro, resolver, or ac pot data. Controls are provided for gain and damping. These controls set the static loop gain and the system stabilization. Model 762A has a built-in power supply, operates directly from a 117 v, 60 cps line. Transistor circuits are stabilized against thermal runaway and no damping tachometers are necessary for system stabilization. Full output is obtained for 200 mv rms into the input impedance of 100 k. The carrier phase shift is +90 degrees. **Industrial Control Co.**, 805 Albin Ave., Lindenhurst, L. I., N. Y.

Circle 467 on Page 19

Variable-Voltage Control



Suitable for drive functions such as regulation of speed and tension, variable-voltage control is designed for 1 to 200 hp motors operating on either 50 or 60 cycles. It provides constant torque over an 8 to 1 speed range. A supply of three-phase 208/220 or 440 v power can be used. The unit in the illustration (Model AVR) is rated at 40 hp, 440 v, three phase, 60 cycles. The opening and closing of the power circuit is performed ahead of the rectifier. This design eliminates the dc contactor and provides the advantages of ac interruption. **Westinghouse Electric Corp.**, P. O. Box 2099, Pittsburgh 30, Pa.

Circle 468 on Page 19

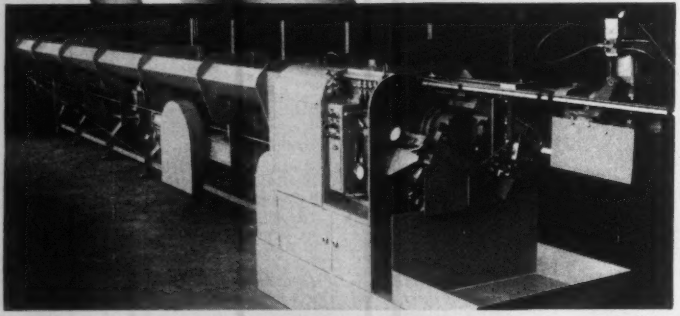
FAST, AUTOMATIC CUT-OFF of TUBING and BAR STOCK
with automatic loading, combined with forming, grooving, flanging or chamfering in a single operation!

the Modern Way

The illustration shows the Modern Automatic Cutting-Off Machine, equipped with automatic feeder which holds up to 100 bars of 3" stock. Stock can be random lengths, which are fed, measured, trimmed and cut.

This machine, known for years for its fast, efficient cutting-off, can now be equipped with special tooling for grooving, flanging, forming and chamfering while cutting-off at a high rate of speed.

The cost savings made possible by combining these operations merit your serious consideration. If you have to cut tubing or round bar stock — particularly with grooves or forming required near the ends — send your prints for our recommendations.

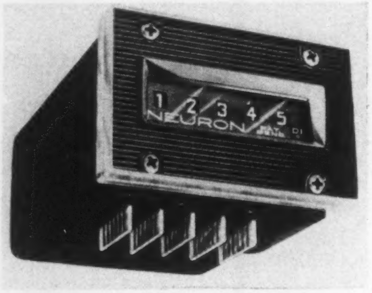


WRITE for CATALOG
New catalog describes all models—gives production figures. Mailed on request.

110

MODERN MACHINE TOOL CO.
2005 Losey, Jackson, Michigan

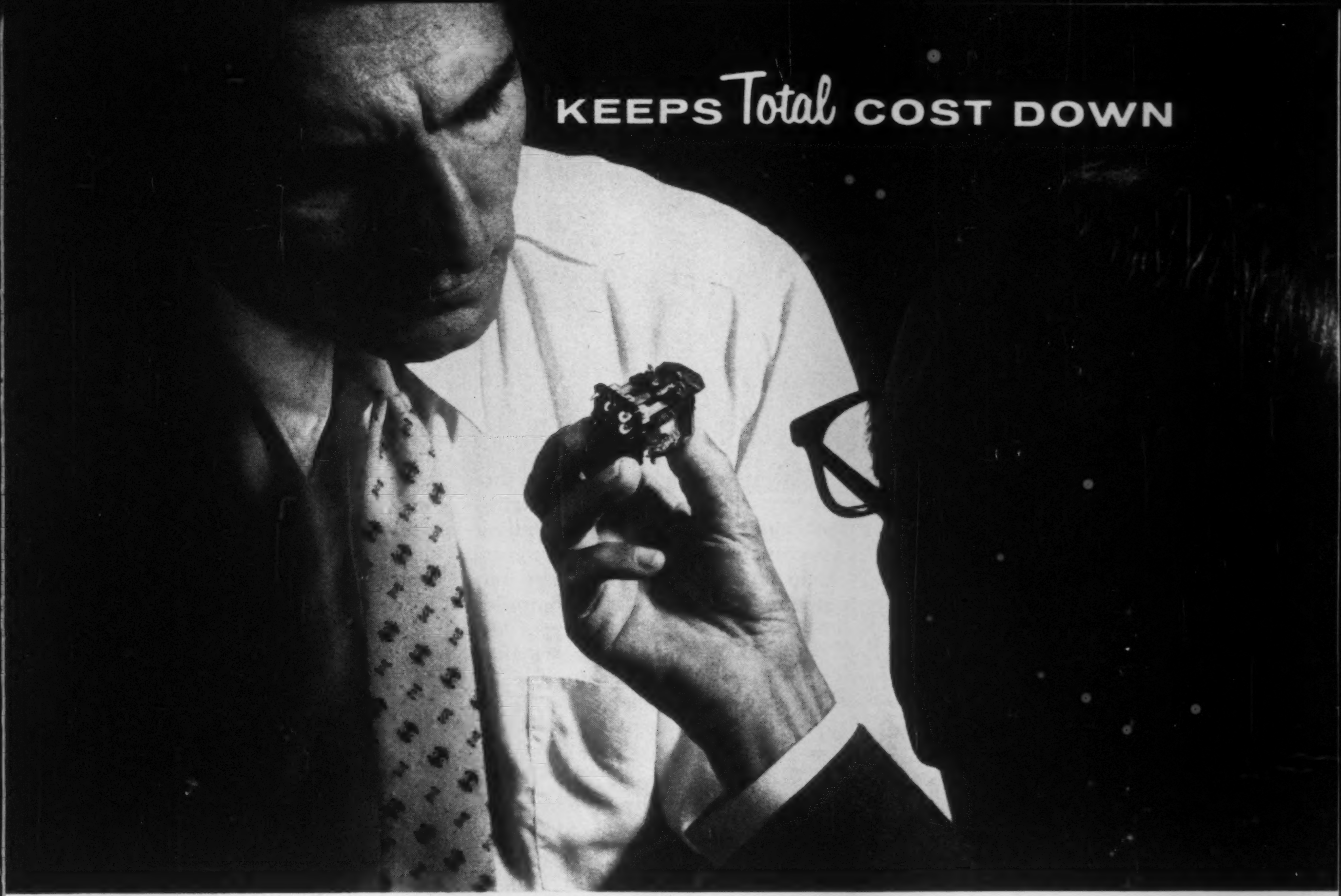
Circle 728 on Page 19



Switching Counter

Five digit readout counter can be used to provide position of almost any discrete variable or for storing in-out information for tabulation. The 40-count-per-second unit has a bidirectional stepping mechanism for adding and subtracting which prevents double indexing during shock, vibration, or voltage surges. Feature of the counter is the switch readout which is an etched 10-point switch and circuit combination that makes each point on the switch externally available. Models are available for 24 v dc, 90 v dc, or 110 v ac. **Data Instruments Div., Telecomputing Corp.**, 12838 Saticoy St., North Hollywood, Calif.

Circle 469 on Page 19



IF INSTALLED-COST IS A DESIGN PROBLEM

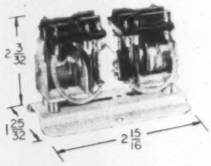
Look at the KA general purpose RELAY

What do your relays cost *installed?* Initial cost is never the whole story.

Our KA Relays are engineered for modern production methods. They're available with printed circuit, taper tab, quick-disconnect or hook solder terminals . . . are simple, economical to install. This fact, combined with low original cost, keeps your total cost down.

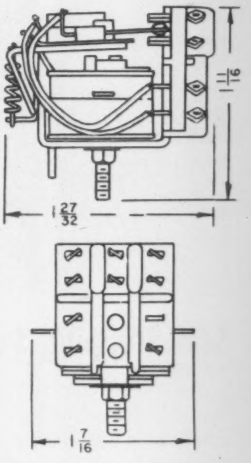
Another source for savings! All standard KA ac relays bear U/L and Canadian Standard Association seals of approval.

Write or call for more information or see the complete P&B catalog in Sweet's Product Design File.



KB LATCHING RELAY consists of two KA Relays, forming a mechanical latching relay, featuring a large number of contact arrangements.

KA ENGINEERING DATA



GENERAL:

Insulation Resistance: 100 megohms min.
Breakdown Voltage: 1500 V. rms between all elements.
Temperature Range:
−55° C. to +85° C. DC
−55° C. to +70° C. AC
Weight: 2.0 ozs.
Pull-In: DC 75% of nominal voltage.
AC 78% of nominal voltage.
Terminals: Taper tabs.
Printed circuit.
Quick-disconnect.
Pierced solder lugs.
Enclosures: Dust Cover
(max. 55° C. ambient for AC relays)
(max. 70° C. ambient for DC relays)

CONTACTS:

Arrangements: 3 Form C (3PDT) max.
Material: Movable—⅛" silver; stationary—5/32" wide silver overlay.
Load: 5 amps @ 115 V. AC 60 cps res.

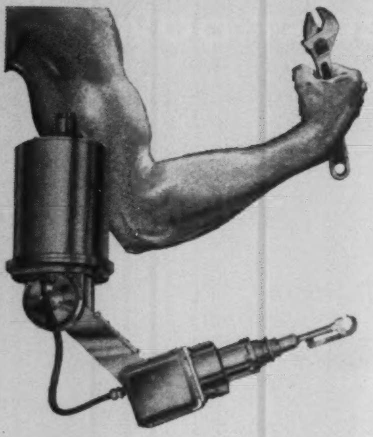
COILS:

Resistance: 16,500 ohms max.
Power: 1.2 watts (DC), 2 volt amps (AC)
Duty: Continuous AC or DC (DC coils will stand 4.5 watts at 25° C.)

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR

POTTER & BRUMFIELD
DIVISION OF AMERICAN MACHINE & FOUNDRY COMPANY, PRINCETON, INDIANA
IN CANADA: POTTER & BRUMFIELD CANADA LTD., GUELPH, ONTARIO

Circle 729 on Page 19



When is an arm more than an arm?

That's easy! When it incorporates superhuman strength, dexterity, versatility . . . and programmed manipulation!

The General Mills Mechanical Arm can duplicate—and in many ways excel—the complex motions of the human arm. For over a decade, this remotely controlled manipulator has served the atomic industry; operating in radioactive areas which are biologically "off limits" to man.

Now, directed by an automatic analog controller, this modern "Samson" is ready to take its place on your industrial production line—repetitively performing difficult, hazardous operations in any working environment. General Mills' principle of analog control can be compared with the function of an imaginary "electrical cam." This controller, a relatively simple memory device, provides precise, positive recording *and* tireless, perpetual playback of a series of random, nonlinear motions.

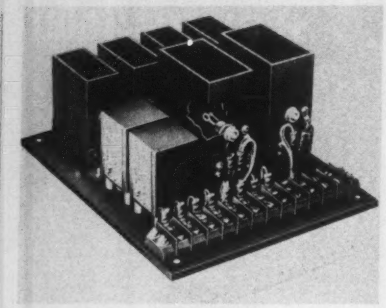
If automatic programming of complex manual operations—and the consequential savings in time and money—can conceivably benefit some phase of your production, we would like to hear from you. We'd appreciate an opportunity to discuss with you a specific application of an analog controlled Mechanical Arm—and how it can be readily adapted to serve you.

Write today!

NUCLEAR EQUIPMENT DEPARTMENT
419 North 5th Street
MECHANICAL DIVISION
Minneapolis 1, Minn.

General Mills

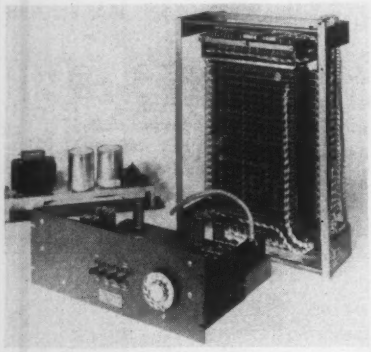
Circle 730 on Page 19



Power Control Unit

Applicable on automatic control systems for processing, packaging, machine tool, and material handling operations, line of power control units utilizes magnetic gating amplifiers driving silicon controlled rectifiers. Five system types designed for proportional or switching control are included in the line. All five types are available for 60 cps or 400 cps supply systems, can be modified for special requirements. Power outputs range from 200 to 2500 w. Sensitivity is 100 microamperes for full output, response is 1 cycle of supply. The units will function in temperatures ranging from −55 to +100 C. **Magnetic Amplifiers Inc.,** 632 Tinton Ave., New York 55, N. Y.

Circle 470 on Page 19

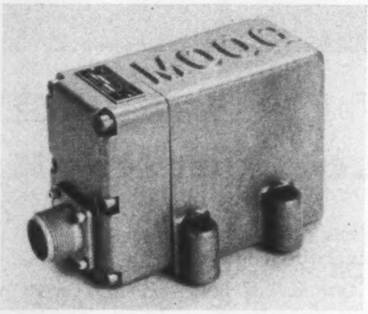


Self Stepping Scanner

Adaptable for thermocouple and strain gage scanning, device is also applicable for testing and selecting automatic circuits, diode and transistor testing, instrumentation computer, and data processing. Unit, designated Model SC-5F, is a modified crossbar switch with a simplified drive circuitry which enables it to connect sequentially a six-wire circuit to each of 100 sets of six-wire terminals at up to 50 sets per second. The six wires can be further divided into single, double, and three-wire circuits.

Unit has twin gold contacts with 30 gram minimum contact pressure which permits scanning of low level signals. Three modes of control are available—self pulsing, external pulsing, and random access by means of a telephone dial. Scanner has a bridging capacity of 20 mmfd to ground and between conductors. Breakdown voltage is not less than 1500 v ac between switching conductors and frame and across switching contacts. Insulation resistance is 10,000 megohms and higher; conductor resistance through the longest path is 0.3 ohm; and current carrying capacity is 100 ma noninductive at 50 v dc for 20,000,000 operations. **James Cunningham Son & Co. Inc.,** 101 Litchfield St., Rochester 8, N. Y.

Circle 471 on Page 19



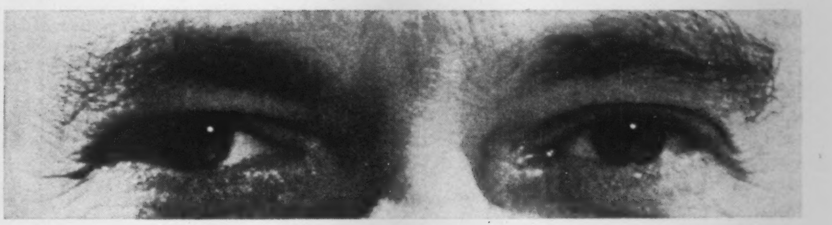
Hydraulic Servovalve

Applicable on automatic machine tools, earth moving machines, material handling equipment, nuclear reactors, and edge controllers, hydraulic servovalve, designated Series 71, will operate at system pressures ranging from 500 to 4500 psi. Valve is available in four sizes—1.0, 2.5, 5.0, and 10.0 gpm rated flow at 1000 psi valve drop and 15 ma input current. It has a cast Meehanite body which is insensitive to industrial environment and is compatible with other hydraulic components. A feature of the valve is the field-replaceable filter which provides added protection of the first stage elements. **Industrial Div., Moog Servocontrols Inc.,** East Aurora, N. Y.

Circle 472 on Page 19

WHO BUT REULAND

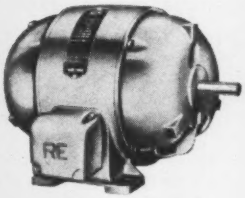
WOULD



OFFER AN

HONOR SYSTEM

MOTOR SERVICE POLICY?



15-Year-Old Service Policy Takes the Word Of Any Local Electric Motor Service Shop of Your Choice

Here is another indication of Reuland quality...and the extent to which our company stands behind its products. It is based on a trust in people, and a trust in Reuland workmanship. It has met the test of time, and captured the acclaim of Original Equipment Manufacturers...and *their* customers.

Whether *your* company is an O.E.M., or a User, the Reuland Honor System Service Policy can be your passport to uninterrupted machine operation. If you are tired of delays while service responsibility is determined...if you would like to talk to a motor company that can look you straight in the eye and be measured, your experience with Reuland could be a revelation.

A free copy is available on request. Explains the simple steps to take. Shows how Reuland's unique philosophy of doing business permits it to offer the industry's only Honor System Service Policy! All company officials should have a copy. We'll mail yours promptly.

MODERN POWER FOR MODERN DAY PRODUCTS
...all in lightweight aluminum frames!

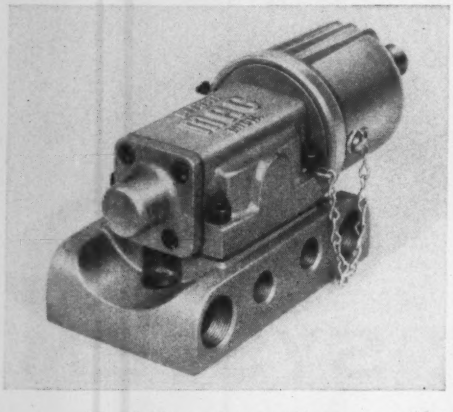
REULAND MOTORS ®

HONOR SYSTEM
MOTOR SERVICE POLICY
RE
REULAND ELECTRIC COMPANY

REULAND ELECTRIC COMPANY
WESTERN DIVISION: *Alhambra, California*
EASTERN DIVISION: *Howell, Michigan*
Distributors in all Principal Cities

For important Reuland Engineering data
refer to Sweet's 1959
Product Design File, section 5a

New Solenoid Air Valves Need No Accessories

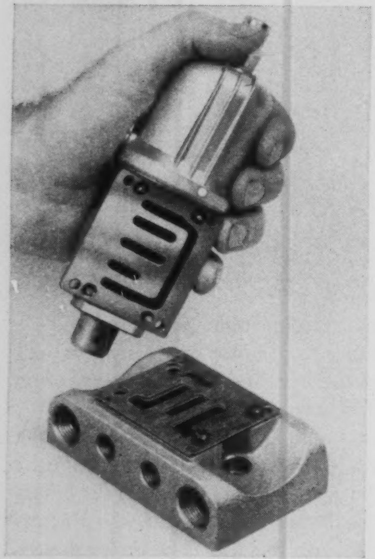


Now available for the first time are solenoid operated air valves complete with all accessories at 'bare valve' prices. Available in 1/4, 3/8, and 3/4 in. port sizes, they come in single- and double-solenoid types in 3-way, 4-way and 4-way 5-port models.

Features include: solenoids interchangeable on all models of a given size; pre-wired plug-in type bases, eliminating customary wiring; standardization of bodies and bases for interchangeability; unusual compactness; elimination of troublesome fasteners in solenoid assembly (which floats in rubber).

All valves are equipped with screwdriver or ball type manual solenoid operators with lock-in and lock-out feature.

Manifold type bases with common inlet exhaust, and conduit, available on 1/4 in. models. For complete information, ask for MAC catalog #60.

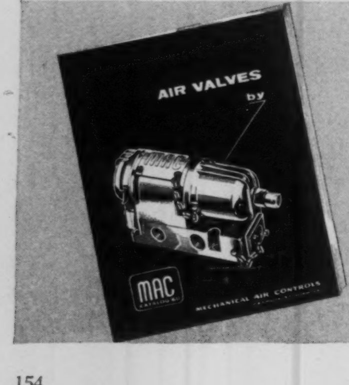


Plug-in Connectors Now Standard on All MAC Solenoid Valves

Pre-wired bases, into which you simply plug in the valve body, are now standard on all MAC solenoid valves—both direct-solenoid and solenoid-air types. Bases are identical for single- and double-solenoid valves of a given size.

The same principle is also applied to the "add-a-unit" manifold type bases available for all MAC solenoid valves. With these, from 2 to 10 valves can be coupled with common inlet, exhaust and conduit. Individual valves can also be isolated or pressure fed in from each end.

With plug-in leads provided on all solenoids, wiring of valves has been reduced to the utmost in simplicity.



NEW!

Write today for this free air-valve manual and catalog.

You'll be surprised at how much time it will save you in picking just the right valve for your application. Ask for Catalog #60.

advances in

PNEUMATICS

MAC

evolution of valve seals . . .

While metal-to-metal seals work well in hydraulic valves, where inherent leakage is accepted, positive leakproof sealing is mandatory in air valves. Flexible seals are today accepted as vital and they must be so designed that sealing efficiency increases with pressure. The seal should be self-cleaning so that foreign matter won't cause leakage.

At one time O-rings were thought to be the answer. O-rings are excellent for static sealing or where travel is short. O-rings are unsatisfactory, however, when used as valve seals crossing an orifice due to the shearing action.

Developing the best design and compound for air-valve seals was a long and tedious job, since elasticity, durometer hardness, compression set, and co-efficient of friction are also important factors.

Experience to date has proven that the best valve seal is a special Buna-N base self-lubricating oil-resistant compound—bonded to the metal to keep it from distorting.

This is the type of seal used in MAC valves. We believe it represents an ideal combination. At least, their amazingly long life in MAC valves seems to confirm that belief.

President

MAC

MECHANICAL AIR CONTROLS, INC.
10030 Capital, Oak Park • Detroit 37, Michigan

Circle 732 on Page 19

AUTOMATION catalogs and literature

Latest automation information. For copies use card on page 19.

Instrumentation Systems

Panellit Service Corp., Div., Panellit Inc., 7401 N. Hamlin Ave., Skokie, Ill.—16 page booklet—Instrumentation and automation systems from installation through start-up service are covered in Bulletin 107. Facilities and services described include a contract organization furnishing installation drawings and installation of the panels, field instruments, the field interconnections, commissioning, operator orientation, and providing supplementary instrumentation personnel where needed.

Circle 473 on Page 19

Polishing & Buffing Machines

Acme Mfg. Co., 1400 E. 9 Mile Rd., Detroit 20, Mich.—12 page booklet—Data are given on rotary machines for polishing and buffing, deburring, wire brushing and micro-finishing. Three types of machines are available—indexing, continuous, and combination in indexing table sizes from 10 inches to 10 ft. in diameter, and up to 24 ft with continuous tables. Notes are also included on accessory equipment.

Circle 474 on Page 19

Automatic Test Equipment

Kearfott Co. Inc., Little Falls, N. J.—15 page booklet—Reports are given on five automatic go/no-go test equipment components designed for high-volume testing of fixed and variable resistors, fixed and variable capacitors, transistors, and diodes. Details are given on the characteristics and operation of the various units, aided by schematic diagrams.

Circle 475 on Page 19

Dehydration Units

J. F. Pritchard & Co. of Calif., Div., J. F. Pritchard & Co., 4625 Roanoke Parkway, Kansas City 12, Mo.—8 page bulletin—Unit, designated Hydryer, described in Bulletin 16.0.081 is a packaged dryer that reduces the moisture content of compressed air or other gases to low dew points or concentrations. Drying process is explained and data are given for selecting a dryer for instrument air. Flow diagrams are included showing full-stream reactivation and split-stream reactivation.

Circle 476 on Page 19

Control Components

Automatic Electric, Northlake, Ill.—12 page booklet—Subassembly packages and complete control systems that are designed by the Industrial Products Division are described. Manufacturing facilities of this department are discussed, with illustrations showing the functions of various departments.

Circle 477 on Page 19

Heavy-Duty Counters

Richardson Scale Co., Clifton, N. J.—4 page pamphlet—Line of heavy-duty counters for indication, recording, and automatic regulation of material flow is described in Bulletin 0159. Design features of five basic types of mechanically actuated counters are explained, and the variations of these basic types that are available are listed. Notes are also given on integrated ticket-printing components and impulsing switches.

Circle 478 on Page 19

Speed Reducers

Cleveland Worm & Gear Co., 3293 E. 80th St., Cleveland 4, Ohio—24 page catalog—Fan-cooled, worm gear speed reducers are outlined in Bulletin 405. Tables list input horsepower and output torque ratings, and charts list application classifications for the reducers. Dimensional drawings of the different styles are included.

Circle 479 on Page 19

Air Gages

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.—32 page catalog—An air gage system and two air gage models are described in Catalog 59D. Instructions are given on how to apportion gaging ranges to suit tolerances and the numbering system for gages is explained. Application photos are included and notes are given on various attachments and accessories.

Circle 480 on Page 19

Sanitary Conveyors

La Porte Mat & Mfg. Co., La Porte, Ind.—6 page pamphlet—Sanitary flexible steel conveyor belts which are outlined in pamphlet are used in the food industry for sorting, washing, freezing, dehydrating, and packaging operations. Data are given on the mesh which is used in the conveyor belts. Specifications and notes on the sprockets are also included.

Circle 481 on Page 19

Automatic Presses

Minster Machine Co., Minster, Ohio—12 page booklet—Automatic presses which produce metal stampings are described. Data are given on straight-side presses which can be equipped with various feed mechanisms and open back gap presses with fixed and inclinable bases. Installation photos show six operations.

Circle 482 on Page 19

Digital Computer Systems

ElectroData Div., Burroughs Corp., 460 Sierra Madre Villa, Pasadena, Calif.—14 page booklet—Electronic computing systems for the petrochemical industry are discussed in Bulletin 3214. It is explained how they can be used for exploration and production, manufacturing and refining, and transportation and pipeline functions in this industry. Details are given on the installation and the continuing service program.

Circle 483 on Page 19

Engineered Containers

Wirebound Box Manufacturers Association, 327 S. LaSalle St., Chicago 4, Ill.—16 page booklet—Wirebound boxes and crates for shipping and materials handling operations are described. Construction principles are explained with sketches showing how different materials are used for specific requirements. Numerous illustrations show the variety of products that can be handled.

Circle 484 on Page 19

Carbon Dioxide Welding

Hobart Brothers Co., Troy, Ohio—38 page handbook—Carbon dioxide welding of mild steel and low alloy steels is the subject of Bulletin EW-208. Data are given on equipment and power sources, welding costs, deposition rates, welding preparation and positioning, electrode wires, weld metal properties, test specimens, and welding factors. Application photos of automatic machines are included.

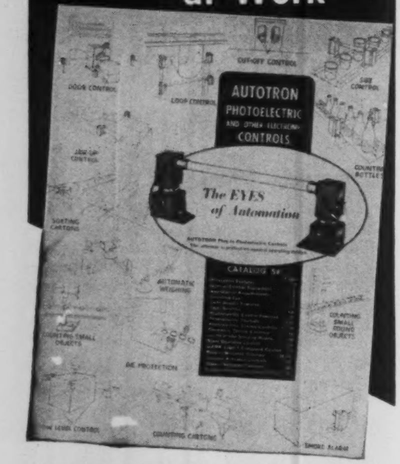
Circle 485 on Page 19

Adjustable-Speed Drives

Reliance Electric & Engineering Co., 24701 Euclid Ave., Cleveland 17, Ohio—12 page booklet—Line of all-electric, adjustable-speed drives ranging from 1/8 through 4 hp is described in Bulletin D-2507. Application data, specifications, dimensions, and a gearmotor selection table are given.

Circle 486 on Page 19

EYES of Automation at Work



New AUTOTRON Catalogs show wide selection of modern industrial photoelectric equipment including the latest in tubeless controls. Also application diagrams of automatic conveyor control, inspection, carton sorting, smoke detection, die protection, counting, weighing, limit and tension control, conveyor jam-up control, spraying and processing control, ramp traffic control, etc.

Send for your copy today.

AUTOTRON, INC.

Box 722 RRN Danville, Ill.

Representatives in principal cities

Circle 733 on Page 19

Hydraulic Valves

Rivett Inc., Brighton 35, Boston, Mass.—20 page booklet—Data are contained in Bulletin 230 on line of pressure controlled hydraulic valves rated for 3000 psi, which can be used for relief, sequence, reducing, unloading, and counterbalancing functions. Notes are given on how to select a valve, discussing points such as normal spool position, operating pressure source, and pilot or direct operation. Types of mountings are described, aided by dimensional drawings.

Circle 487 on Page 19

Water Control System

Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio—8 page bulletin — Subject of Bulletin 530 is a three-element feed water control system which operates from steam flow from the boiler; feed water flow to the boiler; and water level in the boiler drum. Schematic diagrams and installation photos are given and charts show accuracy of water level obtained under varying load conditions.

Circle 488 on Page 19

Thyratron Tubes

CBS-Electronics, Parker St., Newburyport, Mass.—4 page pamphlet—Bulletin PA-223, entitled "Thyratrons Are Different," explains how these tubes are different from standard type tubes. The mechanism of ionization is described, as is the characteristic curve. The effects of temperature on ionization time and tube life and installation precautions are also given.

Circle 489 on Page 19

Photoelectric Instrumentation

Photomation Inc., 96 S. Washington Ave., Bergenfield, N. J.—2 page pamphlet—Photoelectric cells and their application in the process industries are described in Bulletin 522. Some of the installations made for instant monitoring of process flows are pointed out and techniques used for either gases or liquids are explained. Also included are drawings of sample tanks and mounting boxes.

Circle 490 on Page 19

Digital Voltmeters

Non-Linear Systems Inc., Del Mar, Calif.—20 page booklet—Four and five-digit voltmeters for measuring ac and dc voltages and voltage ratios are described in Bulletin 8159. Details are given on the transistorized logic which is performed by semiconductors. Operating information and wiring diagrams are included and illustrations show the input and output accessories.

Circle 491 on Page 19

Control for Engine-Compressors

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.—4 page pamphlet—Control systems for the automatic operation and protection of gas-engine compressors are described in Bulletin 3276. It is explained how the engine-compressors are applied for gas transmission and distribution, oil and field services, refineries, and chemical and industrial plants.

Circle 492 on Page 19

Conductivity Bridges

Industrial Instruments Inc., 89 Commerce Rd., Cedar Grove, N. J.—25 page handbook—Battery and line operated Solu bridges and controllers are described in Bulletin 14479D. Basic principles of operation of various conductivity bridges and cells are explained and instructions are given for the operation of controllers and bridges. The correct methods of use, trouble-shooting, and maintenance procedures are also covered.

Circle 493 on Page 19

Motors & Generators

Imperial Electric Co., 84 Ira Ave., Akron 9, Ohio—6 page pamphlet—Ac and dc electric motors and generators are outlined. Types of units include: Squirrel-cage ac motors, special purpose motors, wound-rotor motors, direct current motors, generators and motor-generator sets. The range of motors covered is from 1 to 200 hp; motor-generator sets from 1/2 to 150 kw.

Circle 494 on Page 19

Electronic Instrumentation

Swartwout Co., 18511 Euclid Ave., Cleveland 12. Ohio—8 page bulletin—Entitled "A Functional Guide to Autronic Control Equipment," Bulletin A-913 features a large illustrated chart on which all the major system components are arranged functionally so the reader can see what control instrumentation is available for a given process variable. The chart also defines the over-all scope of application of the electronic system. Basic principles of operation of the system are given and descriptions of the components used in the system are included.

Circle 495 on Page 19

Processing Equipment

B-I-F Industries Inc., 345 Harris Ave., Providence 1, R. I.—8 page bulletin — Equipment, systems, and controls for the process industries are outlined in Bulletin B-I-F 5-1. This includes flow meters, process instrumentation for remote metering and control, feeders, and feeding systems for liquids and solids. Notes are also given on blenders and proportioning pumps.

Circle 496 on Page 19

ACRO WELDER MFG. CO.

MILWAUKEE

WELDING ENGINEERS

MACHINERY BUILDERS

ESTABLISHED 1936

Circle 734 on Page 19

Conveyors

Conveyor Div., American MonoRail Co., Fourth & Franklin Streets, Tipp City, Ohio—16 page booklet—Two types of conveyors are described in Catalog CD-B —"Cable-Way" and "Chainless" conveyors. The "Cable-Way" conveyor is a conventional trolley system pulled by a continuous cable, driven by powered sprocket-wheels. Capacities are 80, 160, and 250 lb per trolley. The "Chainless" conveyor has eight-wheeled trolleys which are connected by steel rods terminating in ball and socket joints. Capacities are 100 to 400 lb per trolley.

Circle 497 on Page 19

Versatile Computer

Western Div., Computer Control Co. Inc., 2251 Barry Ave., Los Angeles 64, Calif. — 14 page booklet — Instrument, which is a combination digital computer, digital differential analyzer, and logical design implementer, is the subject of Catalog S1. It is explained how the machine can be expanded because of plug-in logical elements. Operation codes and physical components are noted and a block diagram of the computer is given.

Circle 498 on Page 19

Industrial Fans

Lehigh Fan & Blower Div., Fuller Co., Catasauqua, Pa.—28 page catalog—Data are contained in Bulletin L-5 relating to capacities and construction of a line of industrial fans. Rating tables list volumes of delivered air, rpm, horsepower at various static pressures, and outlet velocity and velocity pressures. Graphs show a typical fan performance curve and the friction of air in straight ducts in terms of cubic feet moved per minute.

Circle 499 on Page 19

Time Delay Relay

AGA Div., Elastic Stop Nut Corp. of America, Elizabeth, N. J.—4 page pamphlet—Subject of Bulletin SR-10 is a dial head time delay relay which can be used in motor control applications, conveyor systems, on gas and oil burning equipment, and for continuous automatic cycling operations. Operation of the relay is explained and contact capacities and timing ranges are listed. Notes are also given on mounting and installation accessories.

Circle 500 on Page 19

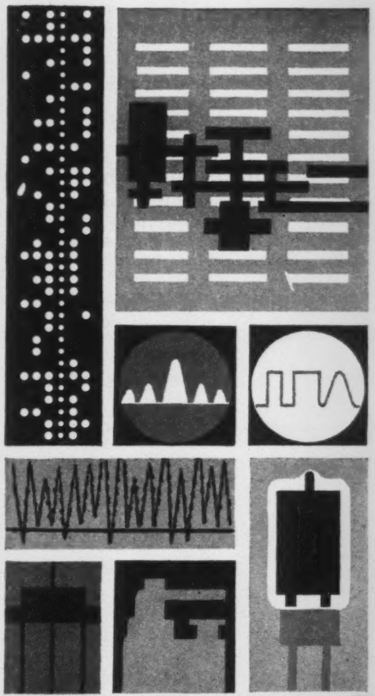
Hydraulic Press Brakes

Verson Allsteel Press Co., 9300 S. Kenwood Ave., Chicago 19. Ill.—16 page booklet—Data are contained in Catalog HPB-59 on line of hydraulic press brakes ranging in capacity from 150 tons to 1800 tons. Photos show the design features and sketches show the construction of different types of press brake dies. Other photos show the different models in the line.

Circle 501 on Page 19

Silicon Controlled Switch

Solid State Products Inc., One Pingree St., Salem, Mass.—30 page handbook—Survey of some circuit applications of the



why control engineers make

FASTER PROFESSIONAL PROGRESS

at General Electric's expanding Specialty Control Dept.

With more than 70% of the business broadly-based in commercial work, G.E.'s Specialty Control Department couples the advantages of long-term stability with fresh engineering challenge in the rapidly expanding field of industrial automation and control.

Today's emphasis on new and larger markets for automatic machine program controls, automated manufacturing equipment and systems provides unusual professional potential for the engineers who join us now.

In addition, military programs here which involve control components and systems for aircraft, missiles and ground support equipment offer a growing share of unique technical assignments.

Systems under development utilize a variety of advanced components and techniques, including:

ELECTRICAL & HYDRAULIC SERVO SYSTEMS / ELECTROMECHANICAL TRANSDUCERS / TRANSISTORS / MAGNETIC AMPLIFIERS / PHOTOELECTRIC DEVICES / INFRARED / MICROWAVE / DIGITAL CIRCUITRY / INFORMATION HANDLING SYSTEMS / MINIATURIZED, SEALED RELAYS

Starting salaries range from $6,500 to $14,500 for positions immediately available in areas of:

ADVANCE PRODUCT ENGINEERING / RELIABILITY ENGINEERING / MANUFACTURING ENGINEERING / DESIGN ENGINEERING / TECHNICAL WRITING / PRODUCT PRODUCTION ENGINEERING

For a prompt evaluation of your qualifications in light of current opportunities, forward your resume in confidence to Mr. D. Hogan, Dept. 13-MK.

SPECIALTY CONTROL DEPARTMENT

GENERAL ELECTRIC

Waynesboro Virginia

Circle 735 on Page 19

silicon controlled switch and silicon controlled rectifier are given in Bulletin D420-02. A comparison to other switching elements is made. Some of the other points covered include: Basic dc pulse and sweep circuits, logic input circuits, proportional control circuits, and ac static switching.

Circle 502 on Page 19

Digital Printers

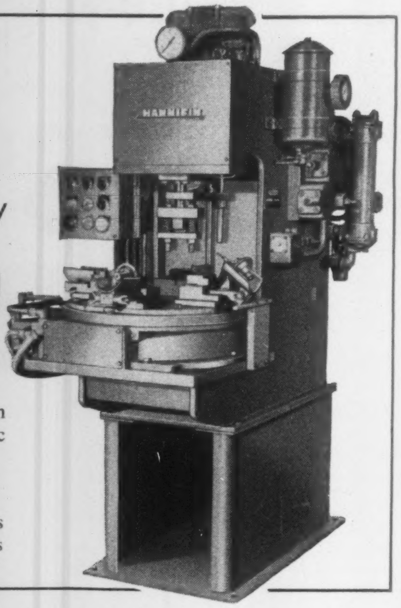
Victor Adding Machine Co., 3900 N. Rockwell St., Chicago 18, Ill.—8 page bulletin—Solenoid actuated digital printers described in Bulletin 671-71-3 can be used with paper tape punches and readers, punched tape typewriters, electronic counters, digital testing equipment, analog-to-digital devices, and time interval meters. Operation and design features of both high speed serial and parallel entry printers are explained.

Circle 503 on Page 19

Thread Rolling Machine

Landis Machine Co., Waynesboro, Pa.—10 page bulletin—Machine, designated Lan-Nu-Rol, is the subject of Bulletin E-101. Design of the machine is based on a two-roll principle and is ideally suited to infeed and thru-feed rolling. The control and cycling system and the power transmission system are explained, as are the cooling system and fixturing.

Circle 504 on Page 19



NOW...index tables

FOR MORE
ECONOMICAL
PRODUCTION
ON THESE NEW

HANNIFIN

"FD" PRESSES

Heavy-duty open-gap production presses with Hannifin hydraulic index tables . . .

Available in all of these sizes:

2, 3, 4, 5 and 6-ton bench models
6, 8, 10, 12 and 15-ton floor models

WITH THESE FEATURES...

- Dual Safety Hand Lever Controls
- Dual Electric Push-Button Controls
- Adjustable Stroke Control
- Reverse on Pressure or Distance
- Full Automatic Cycling
- Hannifin High Speed Hydraulic Index Tables
- Reciprocating Hydraulic Slide Feeds

USE THEM FOR...

- Assembly Operations
- Riveting—Staking
- Forming—Stamping
- Trimming Die Castings
- Trimming Plastics
- Molding Semi-Conductors
- Preformed—Compacting

Call in your nearby Hannifin man—he's a trained production analyst—to prove how you can do more at lower cost with Hannifin presses. Or, write for our new Bulletin 132. It tells the whole story.

HANNIFIN COMPANY

541 South Wolf Road • Des Plaines, Illinois

A DIVISION OF PARKER-HANNIFIN CORPORATION

Hydraulic Valves

Meter & Valve Div., Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.—10 page bulletin—Full-opening, lubricated spherical plug valves in 16, 20, 24, and 30-inch sizes are described in Bulletin V-602 Rev. 1. Specifications and dimensions are listed and schematic drawings show hydraulic operators, elevated gear and hydraulic operators, and power operation of the valves.

Circle 505 on Page 19

Charting Aids

Chart-Pak Inc., Leeds, Mass.—30 page catalog—Data and illustrations of a group of lines, bars, shapes, patterns, and symbols used in preparing charts, graphs, maps, and layouts are contained in Bulletin E58-100M. Included in the group are tapes for printed circuitry, statistical, graphic, reference, and special symbol tapes, plant and office layout, structural and material conveyor tapes. Notes are given on planning boards and sheets; instructions on how to prepare a plant layout are also included.

Circle 506 on Page 19

Selenium Rectifiers

Semiconductor Products Dept., General Electric Co., Liverpool, N. Y.—27 page handbook—Basic data are contained in Bulletin ECG-402 on such subjects as junction rectifiers, capacitive loading, purposes of capacitance in load, how to boost output voltage, and the effect of capacitance on voltage regulation. Other points discussed include: Recommended incoming test specifications for selenium rectifiers, frequency characteristics of the devices, protective finishes, and forced air cooling.

Circle 507 on Page 19

Electrical Control Centers

Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio—16 page booklet—Data are contained in Bulletin PL 6200 on line of ac motor control centers. Construction materials and features are described and it is explained how the units can be furnished with special control panels, lighting panels, and operator's panels. Space requirement tables are listed and instructions are given for planning and outlining a control center.

Circle 508 on Page 19

Amplifiers & Power Supply

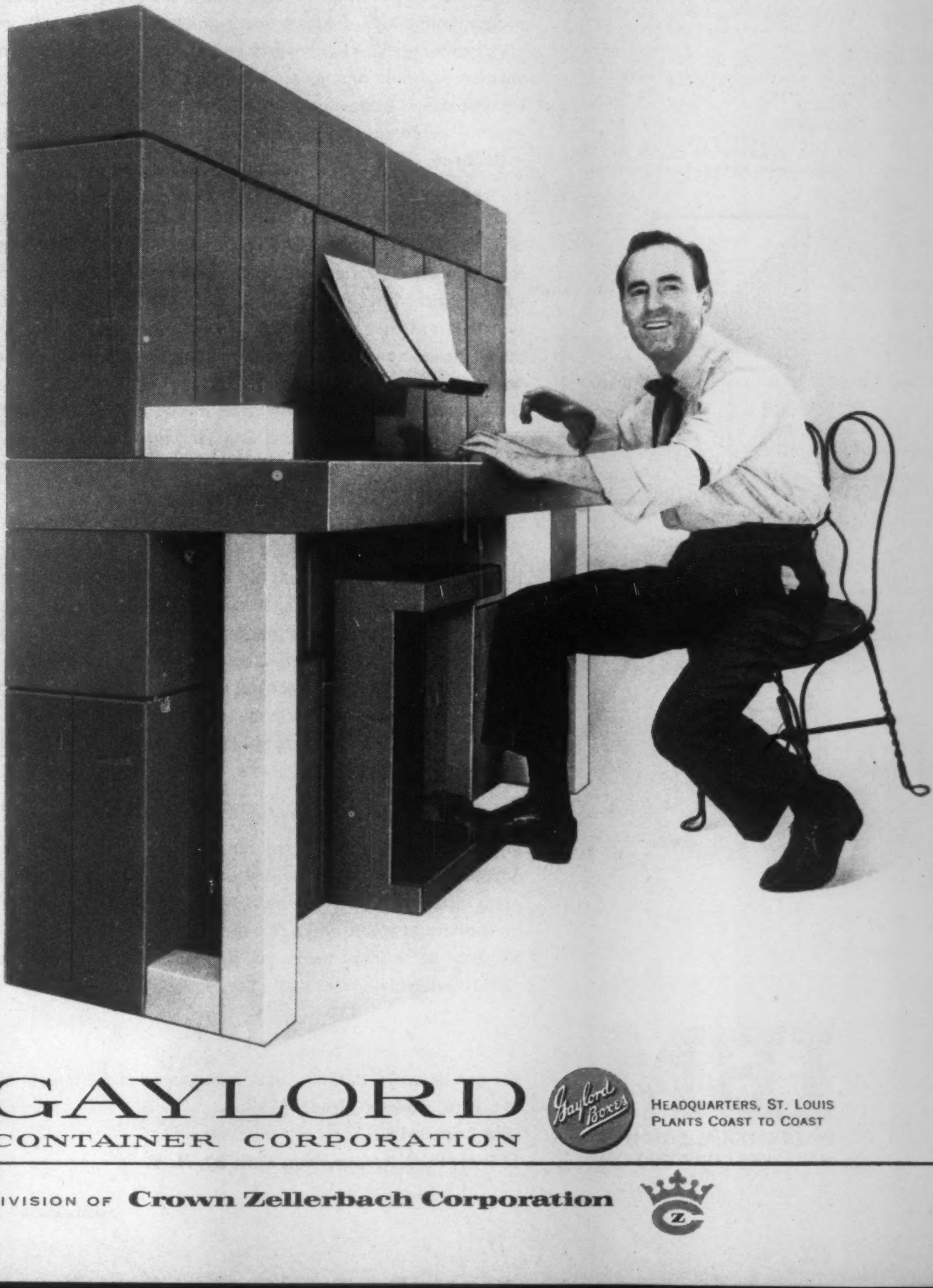
Data Tape Div., Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.—5 data sheets—Miniature, lightweight amplifiers and a power supply for magnetic tape recording are described. The power supply furnishes plate and filament voltage for any combination of 14 record amplifiers. Some of the amplifiers described can convert analog data signals into a frequency-modulated carrier prior to recording on magnetic tape. Photographs and drawings show the operation and different applications.

Circle 509 on Page 19

GAYLORD PLAYS PROGRESSIVE WHEN IT COMES TO PACKAGING

Whether you want a new variation on an old favorite, or a "way-out" box, Gaylord has the experience and vision to compose containers that waltz through your packaging operation.

Be sharp . . . stay in the key of G. Ask your G-Man to sit in on your next packaging session, and watch him harmonize.



GAYLORD
CONTAINER CORPORATION

Gaylord Boxes

HEADQUARTERS, ST. LOUIS
PLANTS COAST TO COAST

DIVISION OF **Crown Zellerbach Corporation**

THREE IBM CAREER OPPORTUNITIES WHERE THE COMMON DENOMINATOR IS

MATHEMATICS

```
      .
      .       ..............
      V       V            .
*********************      .
* 60             60 *      .
*        P.3        *      .
*                   *      .
*     J IS TO 4     *      .
* GREATER   LESS,=  *      .
*********************      .
      .       ..............
      V
*********************
* 70             70 *
*        P.3        *
*                   *
*L(I,K) IS TO 0     *
* GREATER  =  LESS  *
*********************
```

COMPUTER PROGRAMMING at IBM is being extended to include many new areas—such as orbit computation, meteorological satellites, space probes, information retrieval, design automation, real-time systems, and optical studies. As a result, we are greatly expanding our programming staff, creating opportunities for people with various levels of experience. Assignments involve a wide variety of problems in science, business and government.

Qualifications: Degree in Math, Statistics, the Physical Sciences, Engineering or Engineering Science . . . plus one year's programming experience.

MATHEMATICS RESEARCH at IBM involves interesting challenges in a wide variety of areas. These include matrix algebra; logic; mathematical physics; and probability, communication and information theory. Other fields which are also being subjected to intensive study are numerical analysis, combinatorial topology, and operations research.

Qualifications: B.S., M.S., or Ph.D. in Math, Physics, Statistics, Engineering Science, or Electrical Engineering—and proven ability to assume important technical responsibilities in your sphere of interest.

APPLIED MATHEMATICS offers unusually fine opportunities for the math-oriented. You will be asked to apply your knowledge of mathematical and statistical analysis, probability, logic, and coding to advanced computer development problems. Assignments may take you into computer systems design, component engineering, human factors engineering, or feed-back control theory, information and communication theory, inertial guidance, and scientific programming.

Qualifications: B.S. or Advanced Degree in Math, Physics, or Statistics —plus related experience.

There is a wide and diverse range of career opportunities at IBM. Advancement is rapid. The demands of a constantly expanding program of research and development, and promotion from within, based on individual merit and achievement, make this possible. Working alone or on a small team, you'll find that specialized assistance is readily available.

IBM®

INTERNATIONAL BUSINESS
MACHINES CORPORATION

For details, write, outlining your background and interests, to:
Mr. R. E. Rodgers, Dept. 521K.
IBM Corporation
590 Madison Avenue, New York 22, N. Y.

AUTOMATION abstracts

SEQUENCE DIAGRAMS SPEED MACHINE TROUBLESHOOTING

By JOHN E. CRAIG
Process Development Staff
General Motors Corp.
Detroit, Mich.

IN RECENT YEARS, technological developments have resulted in increasingly complex machine tools and manufacturing equipment. Typical of these developments are automatic feeding devices; hydraulic, electrical, or pneumatic actuators; feedback control; and sensitive electronic gaging, inspection, and control devices. Each of these developments has contributed to improvements in efficiency of production processes.

Along with the improvements, however, has come the problem of greater difficulty in troubleshooting when a malfunction occurs in a complex machine. Prolonged downtime due to component malfunction is a costly item. Thus, ease of troubleshooting is a prerequisite in planning today's plant operation for efficient production.

The ease with which a person can troubleshoot a machine depends upon factors such as familiarity with the machine, the manner in which the elementary electrical diagram is drawn, the amount of supplementary information available, the complexity of the machine, and the clarity of the data covering the sequence of machine operation.

The electrical sequence of operation includes an elementary electrical diagram showing the operation of the electrical circuits by a scheme using electrical symbols. Usually a written sequence of mechanical operation is supplied and, for a large machine, is presented in booklet form. The size of the booklet depends on the complexity of the machine.

This method of presenting the electrical and mechanical sequence of operation has, in the past, provided the required information. It has not, however, served as a quick reference for troubleshooting in cases of equipment malfunction. It was felt, therefore, that a simpler and better way of presenting the sequence of operation was needed.

Simplified Method

As a result, engineers of the Process Development Section of the GM Process Development Staff undertook a project to find a simple, yet effective, method for representing the sequence of operation. The objective was to develop a method which would permit easy understanding of the machine operation by electricians and other maintenance personnel, and also serve as a quick reference for troubleshooting; thereby achieving the goal of minimum downtime due to locating the causes of malfunctions.

One of the major problems involved was the development of a method using a suitable set of symbols for describing, as simply as possible, the machine motions and sequence of operation. Various methods were developed, tried out, and refined until a set of symbols was finally agreed upon, *Fig.* 1. An example illustrating

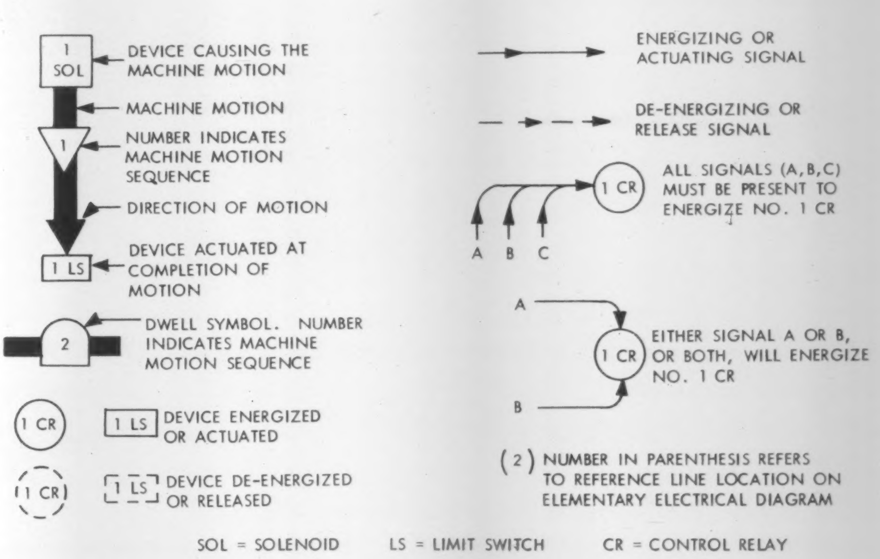

1 SOL
DEVICE CAUSING THE MACHINE MOTION
MACHINE MOTION
1
NUMBER INDICATES MACHINE MOTION SEQUENCE
DIRECTION OF MOTION
1 LS
DEVICE ACTUATED AT COMPLETION OF MOTION
2
DWELL SYMBOL. NUMBER INDICATES MACHINE MOTION SEQUENCE
1 CR
1 LS
DEVICE ENERGIZED OR ACTUATED
1 CR
1 LS
DEVICE DE-ENERGIZED OR RELEASED
ENERGIZING OR ACTUATING SIGNAL
DE-ENERGIZING OR RELEASE SIGNAL
1 CR
ALL SIGNALS (A,B,C) MUST BE PRESENT TO ENERGIZE NO. 1 CR
A
B
C
A
1 CR
B
EITHER SIGNAL A OR B, OR BOTH, WILL ENERGIZE NO. 1 CR
(2) NUMBER IN PARENTHESIS REFERS TO REFERENCE LINE LOCATION ON ELEMENTARY ELECTRICAL DIAGRAM
SOL = SOLENOID
LS = LIMIT SWITCH
CR = CONTROL RELAY

Fig. 1—Symbols shown were developed by GM Process Development Staff for use in diagrams illustrating sequence of machine operations.

THE MACHINE MOTIONS ARE AS FOLLOWS:

- (a) CYLINDER NO. 1 (CYL 1) MOVES FORWARD
- (b) CYL 1 DWELLS IN FORWARD POSITION
- (c) CYL 1 RETURNS

THE COMPLETE SEQUENCE OF OPERATION IS AS FOLLOWS:

- (a) PRESSING THE PUSH BUTTON (PB) ENERGIZES NO. 1 CONTROL RELAY (1 CR)
- (b) NO. 1 CR ENERGIZES NO. 1 SOLENOID (1 SOL). THIS STARTS CYL 1 FORWARD
- (c) AS CYL 1 STARTS FORWARD IT RELEASES NO. 1 LIMIT SWITCH (1 LS) AND, WHEN FULLY FORWARD, ACTUATES 2 LS
- (d) 2 LS ENERGIZES NO. 1 TIMING RELAY (1 TR). 1 TR THEN STARTS TIMING
- (e) 1 TR ON TIMING OUT DE-ENERGIZES 1 CR WHICH, IN TURN, DE-ENERGIZES 1 SOL
- (f) 1 SOL, ON DROPPING OUT, CAUSES CYL 1 TO RETURN
- (g) CYL 1 ON STARTING BACK RELEASES 2 LS AND, WHEN FULLY BACK, ACTUATES 1 LS
- (h) 1 LS ON OPERATING DE-ENERGIZES 1 TR, ENDING THE CYCLE.

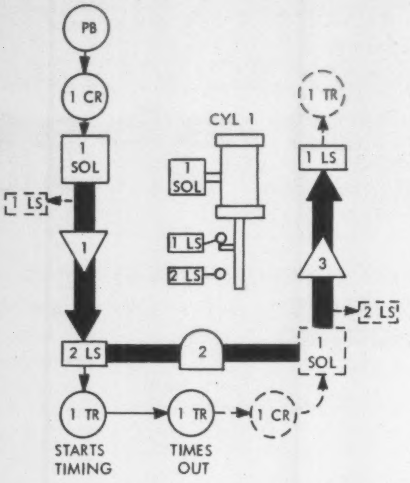


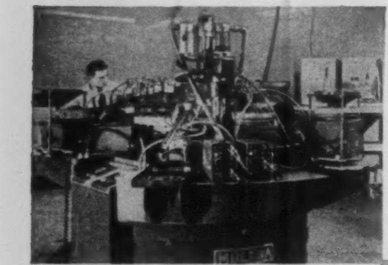
Fig. 2 — Diagram illustrates use of symbols of Fig. 1 to show sequence of electrical and mechanical actions necessary to effect an advance-dwell-return cycle for a cylinder.

an application of the symbols to describe typical machine motions and sequence of operation is shown in *Fig.* 2. The method was found to be adaptable to machines operated by hydraulic, pneumatic, or electrical controls.

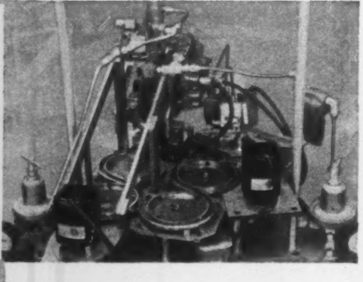
When applying the simplified method to troubleshooting, an elementary electrical diagram of the machine controls is used in conjunction with a sequence of operation diagram. The two diagrams illustrated in *Fig.* 3 and 4 are, respectively, electrical control and sequence of operation diagrams for a vane loading machine that inserts 24 vanes in equally spaced, radial slots in automatic transmission torus shells. By reference to *Fig.* 3 and 4, the sequence of operation of the machine and a sample troubleshooting problem solution may be followed.

Operational sequence of the vane loading machine is: After loading an empty torus shell in the machine, the operator presses a *Cycle Start* pushbutton. This starts the loading cycle. The clamp cylinder raises the empty shell to the loading position and clamps the shell. The index cylinder then indexes the shell into

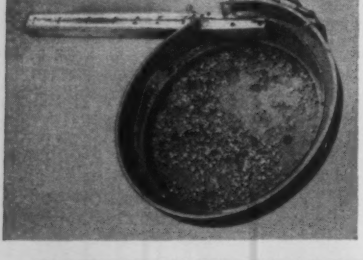
WHAT'S YOUR ASSEMBLY PROBLEM?



MULTI-STATION ASSEMBLY MACHINES
with interchangeable assembly tools.



SINGLE STATIONS
for established production lines.



FEEDERS
custom designed for any operation.

Multra engineers are prepared to assist you in assembling *your* product automatically. Their wide experience in parts handling and assembly problems will quickly enable them to evaluate your product and advise how it may best be handled.

Multra engineers are qualified to take over completely the design and assembly problems related to automatic assembly of a product and to deliver a machine ready to operate in full production. This may be a complex multi-station assembly machine — it may be a relatively simple 3, 4, or 6-station unit, depending on the particular product — or just an individual tool or feeder for an existing line.

You may prefer to do your own tooling design. In that case, a basic Multra indexing machine, without tools, may be purchased.

Sperry Multra engineers are available for consultation — no charge of course. *Write for technical brochure.*

AUTOMATIC ASSEMBLY . . . the key to efficient production.

Sperry MULTRA
AUTOMATIC ASSEMBLY

SPERRY PRODUCTS, INC. • 1211 Shelter Rock Rd., Danbury, Conn.

position against a positive stop. The stripper cylinder next strips a vane from a stack in a magazine and inserts the vane into a radial slot in the torus shell. The stripper cylinder remains in the lowered position while the index cylinder returns. When the index cylinder is fully returned, the stripper cylinder returns and another indexing operation is started. The index cylinder and the stripper cylinder repeat the same sequence until the torus shell is filled with vanes. When the shell is filled, a limit switch is actuated and the stripper and clamp cylinders are returned together, completing the machine cycle.

To illustrate how the simplified method for presenting machine operation sequence information can aid in troubleshooting, assume that the torus shell is clamped and that the index cylinder is in its forward position when a malfunction occurs, shutting down the machine. Analysis of the sequence of operation diagram, *Fig.* 4, shows that the next motion that should have occurred is advancement of the stripper cylinder toward the vane magazine. If, from an inspection of the machine, this action has not occurred, the trouble may be located by working backward from machine motion 3 (advance stripper cylinder) on the sequence diagram to

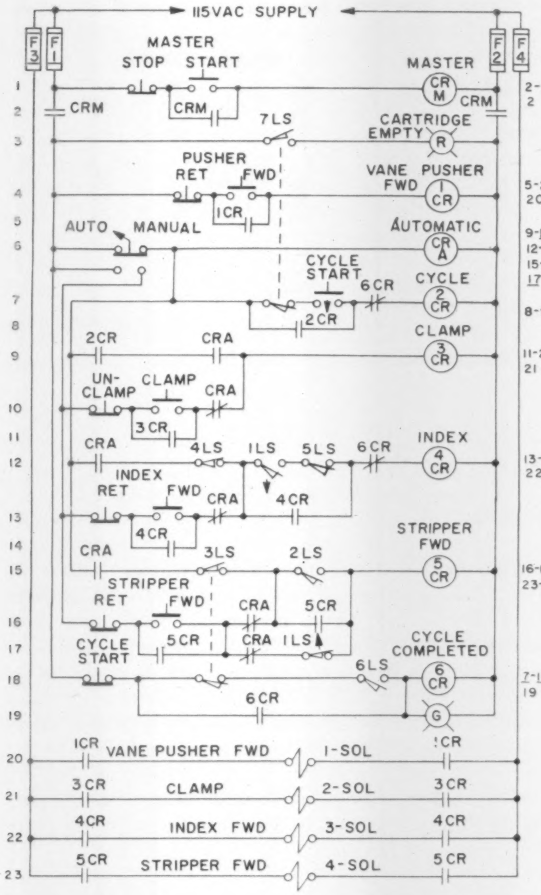
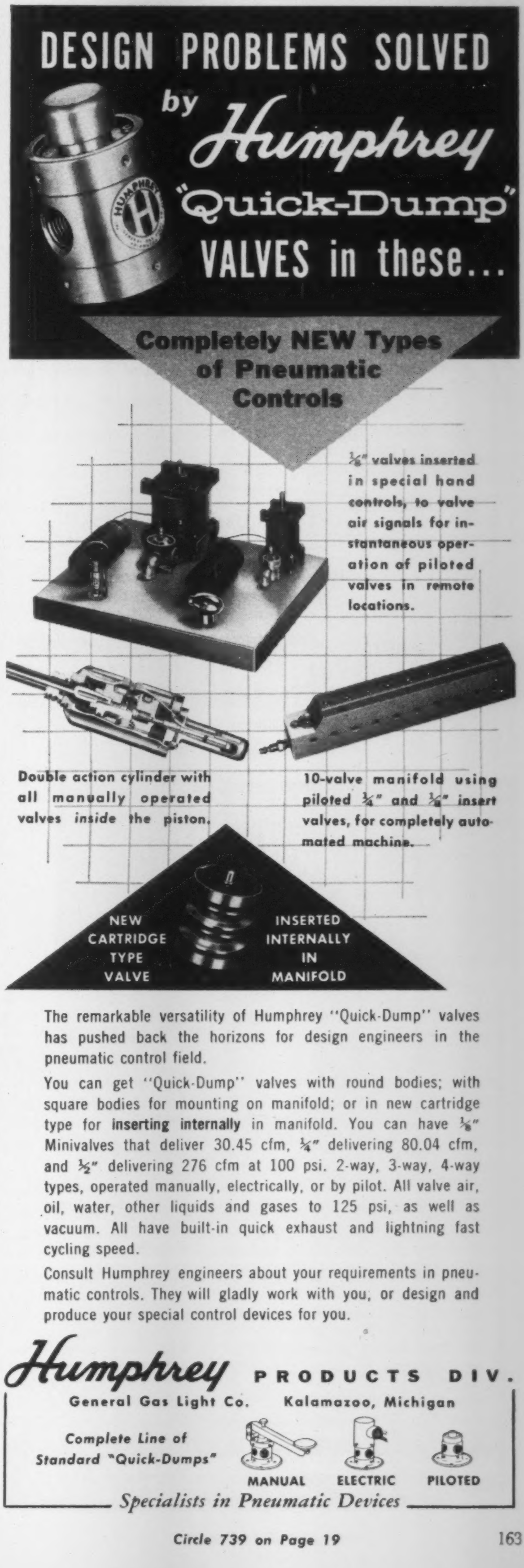

115VAC SUPPLY
F3
F1
F2
F4
MASTER
STOP
START
MASTER
CR M
CRM
CRM
CRM
2-2
2
7LS
CARTRIDGE EMPTY
R
PUSHER
RET
FWD
VANE PUSHER FWD
1 CR
1CR
5-20
20
AUTO
MANUAL
AUTOMATIC
CR A
9-10
12-13
15-16
17
CYCLE START
6CR
CYCLE
2 CR
2CR
8-9
2CR
CRA
CLAMP
3 CR
11-21
21
UN-CLAMP
CLAMP
CRA
3CR
CRA
4LS
1LS
5LS
6CR
INDEX
4 CR
13-14
22-22
INDEX
RET
FWD
CRA
4CR
4CR
CRA
3LS
2LS
STRIPPER FWD
5 CR
16-17
23-23
STRIPPER
RET
FWD
CRA
5CR
CYCLE START
5CR
CRA
1LS
CYCLE COMPLETED
6LS
6 CR
7-12
19
6CR
G
1CR
VANE PUSHER FWD
1-SOL
!CR
3CR
CLAMP
2-SOL
3CR
4CR
INDEX FWD
3-SOL
4CR
5CR
STRIPPER FWD
4-SOL
5CR
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

Fig. 3—Conventional elementary electrical diagram is used in conjunction with sequence of operation diagram of Fig. 4 for troubleshooting a machine that inserts vanes in automatic transmission parts


DESIGN PROBLEMS SOLVED by Humphrey "Quick-Dump" VALVES in these...

Completely NEW Types of Pneumatic Controls

⅛" valves inserted in special hand controls, to valve air signals for instantaneous operation of piloted valves in remote locations.

Double action cylinder with all manually operated valves *inside* the piston.

10-valve manifold using piloted ¼" and ⅛" insert valves, for completely automated machine.

NEW CARTRIDGE TYPE VALVE

INSERTED INTERNALLY IN MANIFOLD

The remarkable versatility of Humphrey "Quick-Dump" valves has pushed back the horizons for design engineers in the pneumatic control field.

You can get "Quick-Dump" valves with round bodies; with square bodies for mounting on manifold; or in new cartridge type for **inserting internally** in manifold. You can have ⅛" Minivalves that deliver 30.45 cfm, ¼" delivering 80.04 cfm, and ½" delivering 276 cfm at 100 psi. 2-way, 3-way, 4-way types, operated manually, electrically, or by pilot. All valve air, oil, water, other liquids and gases to 125 psi, as well as vacuum. All have built-in quick exhaust and lightning fast cycling speed.

Consult Humphrey engineers about your requirements in pneumatic controls. They will gladly work with you, or design and produce your special control devices for you.

Humphrey PRODUCTS DIV.
General Gas Light Co. Kalamazoo, Michigan

Complete Line of Standard "Quick-Dumps"
MANUAL ELECTRIC PILOTED

Specialists in Pneumatic Devices

Circle 739 on Page 19

Bin Stuck Lately?

QUALITY...
Model F
pneumatic, heavy-duty, long life.
ECONOMY...
Model KO
boltless—low initial cost.

Here's quality and economy in two popular Cleveland Air Vibrators . . . Model F and Model KO.

Easily demountable, these vibrators speed the flow of dry materials in bins and hoppers—give users continuous, trouble-free performance.

Don't Bang the Bins!!
CLEVELAND
VIBRATOR

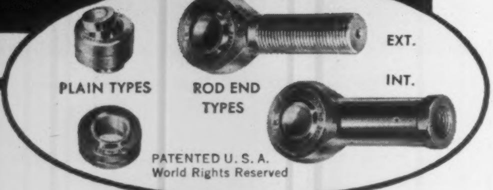
Send now for complete application information and performance data.

THE CLEVELAND VIBRATOR CO.

Dept. 110-2932 Clinton Ave. • Cleveland 13, Ohio

Circle 740 on Page 19

SOUTHWEST
"Monoball"®
SELF-ALIGNING BEARINGS



EXT.
INT.
PLAIN TYPES
ROD END TYPES
PATENTED U. S. A.
World Rights Reserved

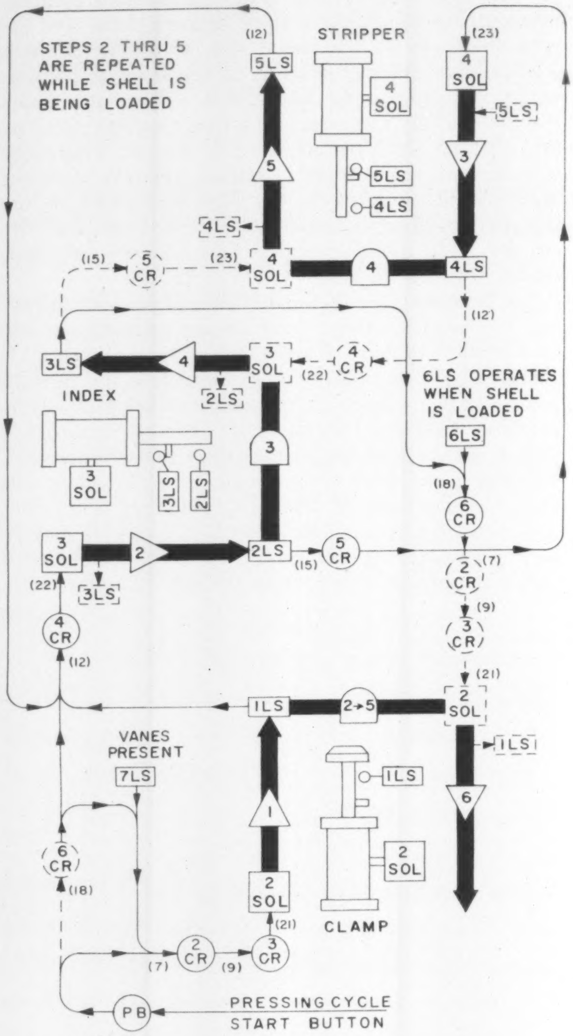
CHARACTERISTICS

ANALYSIS	RECOMMENDED USE
1 Stainless Steel Ball and Race	For types operating under high temperature (800-1200 degrees F.).
2 Chrome Alloy Steel Ball and Race	For types operating under high radial ultimate loads (3000-893,000 lbs.).
3 Bronze Race and Chrome Steel Ball	For types operating under normal loads with minimum friction requirements.

Thousands in use. Backed by years of service life. Wide variety of Plain Types in bore sizes 3/16" to 6" Dia. Rod end types in similar size range with externally or internally threaded shanks. Our Engineers welcome an opportunity of studying individual requirements and prescribing a type or types which will serve under your demanding conditions. Southwest can design special types to fit individual specifications. As a result of thorough study of different operating conditions, various steel alloys have been used to meet specific needs. Write for Engineering Manual No. 551. Address Dept. AUT-59

SOUTHWEST PRODUCTS CO.
1705 SO. MOUNTAIN AVE., MONROVIA, CALIFORNIA

Circle 741 on Page 19



STEPS 2 THRU 5 ARE REPEATED WHILE SHELL IS BEING LOADED
STRIPPER
5LS
4 SOL
4LS
5
3
4 SOL
5 CR
4
4LS
3LS
3 SOL
4 CR
2LS
INDEX
3 SOL
3LS
2LS
6LS OPERATES WHEN SHELL IS LOADED
6LS
6 CR
3 SOL
2
2LS
5 CR
2 CR
3 CR
4 CR
1LS
2→5
2 SOL
1LS
VANES PRESENT
7LS
6 CR
1
2 SOL
2 SOL
CLAMP
6
2 CR
3 CR
PB
PRESSING CYCLE START BUTTON
(12)
(23)
(15)
(22)
(18)
(7)
(9)
(21)

Fig. 4—Sequence of operation diagram permits ready tracing of normal machine actions on automatic cycle and provides clues to trouble spots in the event of malfunctioning of vane loading machine.

machine motion 2 (advance index cylinder), since the latter action occurred successfully. Accordingly, a check would first be made to see if solenoid *4SOL* is energized (reference line 23 on the elementary electrical diagram). If it is not energized, a check is made to see if the coil of relay *5CR* is energized (reference line 15). Should *5CR* not be energized, limit switch *2LS* would be checked to see that it has been actuated by advancement of the index cylinder. Thus, the sequence diagram may be used to provide quick familiarity with the normal machine cycle, and to obtain clues as to the probable locations of faults.

From an article entitled "A Simplified Method for Showing the Operating Sequence of Complex Manufacturing Equipment" which appeared in the General Motors Engineering Journal, Vol. 6, No. 3, July-Aug.-Sept. 1959.

PROGRESS IN AUTOMATIC FREIGHT CAR CLASSIFICATION

By GEORGE W. BAUGHMAN
Vice President
Union Switch & Signal Div.
Westinghouse Air Brake Co.
Pittsburgh, Pa.

NEED FOR and purpose of a freight car classification yard may be explained readily by an example. A train of freight cars arriving at a yard will have cars with destinations in different cities. The problem then is to rearrange the cars to form new trains consistent with the destinations. To accomplish this, each incoming train of cars is moved to a "hump" which is elevated with respect to a large number of tracks in the general shape of a fan. Cars, singly or in groups, are uncoupled as they are moved over the hump and then are accelerated by gravity as they move downgrade to selected destination tracks. A locomotive maintaining a relatively slow speed pushes the cars over the hump where they are uncoupled in accordance with previously prepared instructions.

Two major problems are obvious. First, the track switches must be operated properly so that each car or group of cars will go to the right track. Second, each car or group of cars must move at a speed which will ensure its reaching the proper location, but which is not so great at the moment of contacting and coupling with other cars as to damage lading or equipment.

The advent, in the late twenties, of power operated switches and car retarders did much to reduce the labor cost of manual car classification methods. Car retarders are mechanical devices, electropneumatically or electrically operated, that apply brake shoes on both sides of car wheels as the cars pass on tracks. With these developments, one man in a remote tower was able to handle several switches and retarders and thus control the routing and speeds of cars as they rolled downgrade. Besides making major economies, these developments practically eliminated physical hazards. However, there were still instances of errors in judgment which caused excessive damage to cars and lading. Thus, the climate was set for the automatic classification yard which combines automatic switching and speed control of cars having different rolling resistances.

Automatic Switching

In one form of automatic switching system, a control tower operator depresses a pushbutton on a panel to establish a route from a hump to a particular yard track. Usually, the system is provided with a memory or storage facility so that five consecutive routes may be stored. Storage is accomplished on banks of relays in response to the pushbutton operations. The contacts of the relays cause the proper track destinations to be displayed on an indicator. The number displayed at the top of the indicator refers to the destination track of the first car to go over the hump, and the numbers directly below refer to destinations for the next cars or groups of cars. After the first car moves over the hump, the destination track number for that car is erased from the indicator and all of the

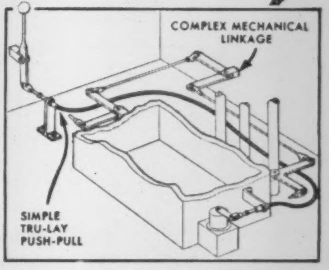
Improved Operation of literally hundreds of mechanical products has been effected with Acco Tru-Lay *flexible* **PUSH-PULL** Controls

Tru-Lay Push-Pull Controls provide POSITIVE REMOTE-ACTION over long or short distances . . . with fixed or movable anchorages . . . for light loads or loads up to 1,000 lbs., and these units are frequently and successfully used in conjunction with Electric, Hydraulic and Air Controls.

Flexibility makes it possible to snake around obstructions . . . simplifies installation . . . reduces the number of working parts . . .

Simplicity vs Complexity

Compare the TRU-LAY PUSH-PULL cable in illustration with the mechanical linkage. PUSH-PULLS are simple, have but one moving part, are noiseless and give lifetime service accuracy. Linkages are complex, made of many parts; they wear at many points. Their use brings increased backlash, lost accuracy and vibration rattles.



Positive Remote-Action and Flexibility, together with Precision and Long Life, explain why TRU-LAY PUSH-PULLS serve designers and users equally well in improving machine operations, whether the application is on such severe service jobs as Bulldozers, Power Shovels and Steel Mill Machinery, or on such light duty work as Photographic Equipment, X-Ray or Business Machines.

Immunity to Vibration makes these TRU-LAY PUSH-PULLS ideal as Remote Controls on shakers and other vibratory products.

Complete Protection Against Dirt and Moisture is a big factor in the use of this unit on machinery in Coal Mines, Cement and Steel Mills, Oil Fields and in many other industries.

Corrosion-Resistance of the unit, plated or with Stainless Steel construction as required by the use, has led to many applications in the Marine Field . . . salt water or fresh. Supplied with a rubber cover the unit operates effectively even when conduit is COMPLETELY IMMERSED.

Lubrication of the inner working member is for life.

Temperatures as low as —70°F will not hinder the proper operation of this unit, and it is thoroughly effective even in the extreme high temperatures encountered on Jet Engine, Furnace Door and Glass Furnace Damper control applications.

Our **DATA FILE** *will answer your further questions. Write for a copy without obligation*

Push-Pull DATA FILE

ACCO
Automotive and Aircraft Division
AMERICAN CHAIN & CABLE

601-S Stephenson Bldg., Detroit 2
6800-S East Acco Street, Los Angeles 22 • Bridgeport 2, Conn.

Circle 742 on Page 19

VIBRA-WASHER

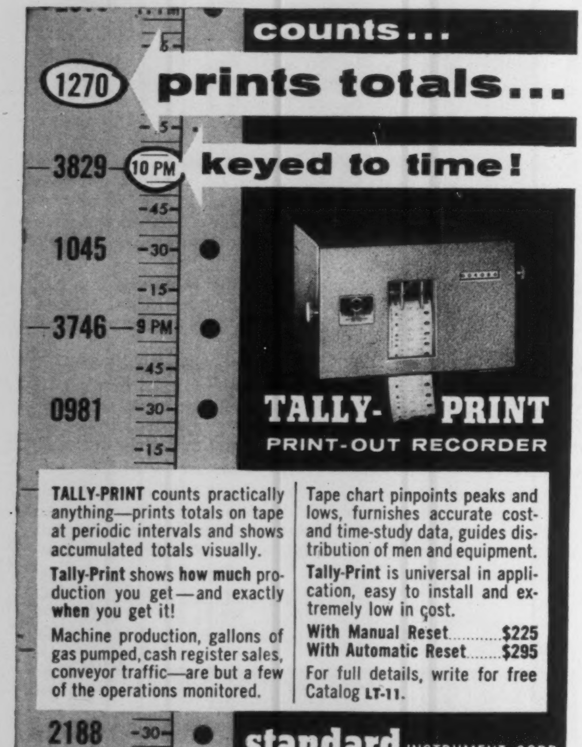
. . . THE COMPLETELY NEW AUTOMATIC PARTS WASHER AND METAL CONDITIONING MACHINE

- **Labor saving**
- **Automatic unloading**
- **For single or multi-stage operations**
- **No nesting of parts during cleaning or conditioning cycle**
- **Adjustable capacities to 10,000 lbs. per hour**

The versatile new Simplicity VIBRA-WASHER, revolutionary machine for washing and conditioning of small metal parts, stampings and castings, employs a vibrating work carrier that automatically conveys parts through cleaning or conditioning bath. Solution is forced around parts, even into blind drillings and slots. In single stage, VIBRA-WASHER removes chips, oil and grease quickly . . . economically. In multi-stage, several units in line will provide cleaning, rinsing and phosphating, eliminating "between-stage" handling. Write today for Bulletin 107, to: Industrial Washer Division.

Simplicity
TRADE MARK REGISTERED
212 ENGINEERING COMPANY • DURAND 26, MICH.

Circle 743 on Page 19



TALLY-PRINT counts practically anything—prints totals on tape at periodic intervals and shows accumulated totals visually.

Tally-Print shows **how much** production you get—and exactly **when** you get it!

Machine production, gallons of gas pumped, cash register sales, conveyor traffic—are but a few of the operations monitored.

Tape chart pinpoints peaks and lows, furnishes accurate cost- and time-study data, guides distribution of men and equipment.

Tally-Print is universal in application, easy to install and extremely low in cost.

With Manual Reset.........$225
With Automatic Reset........$295

For full details, write for free Catalog **LT-11.**

standard INSTRUMENT CORP.
657 BROADWAY, NEW YORK 12, N. Y.

Circle 744 on Page 19

track numbers on lower lines of the indicator move up one line.

Although requests for routes are stored in the sequence of operation of the pushbuttons, there is no movement of any track switch until the car being switched is actually approaching a particular switch. While a car is passing one switch, it causes the information regarding the desired position of the next switch to be passed along. This feature is a necessary part of the system because without it there would be the requirement that no car could be released from the hump until the previous one had cleared the last switch.

Examples of refinements that have been applied to some automatic switching systems include use of perforated or magnetic tape devices for storing destination information, and use of magnetic core type memory units. Regular pushbutton control is usually retained, however, because of the flexibility of this method in taking care of unusual occurrences or errors in the sequence of cars.

Automatic Speed Control

An intermediate step in the development of automatic speed controls was in the use of pushbutton panels whereby a tower operator could select the speed at which a car or group of cars would leave a given car retarder. Control equipment included speed measuring devices such as Doppler-type radar sets and servo arrangements to actuate the car retarders. However, this method still required that an operator estimate the over-all rolling friction of each car handled. Therefore, performance was subject to wide variations depending upon the experience and skill of the operators.

In fully automatic speed control systems, judgment is taken over by sensing devices that observe and measure various characteristics of the cars. The outputs of these devices are fed to a computer that determines the proper exit velocity each car should have for its selected route. Several interesting problems require solution in establishing what these velocities should be.

Rolling resistance of a car is determined as the car moves on an accurately maintained gradient. The acceleration of the car is measured and automatically compared with the theoretical acceleration of a freely rolling body on the particular inclined plane or gradient.

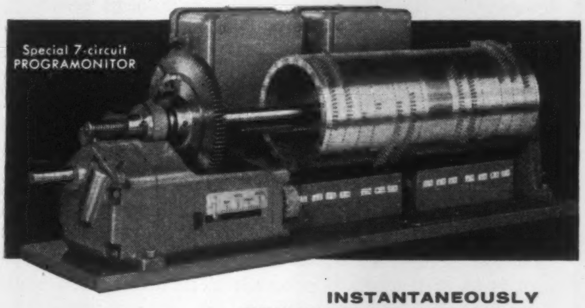
Two methods are commonly used to determine acceleration. In one method, the speed of the car is taken at two different points separated by a known distance. Acceleration is found automatically by solving the applicable formula. The second method employs a Doppler radar unit to continuously measure the speed of the car as it rolls down the gradient. The continuous measurement of velocity is then differentiated to obtain acceleration. A byproduct advantage of this method is that the second derivative of velocity can also be computed. If this quantity is zero, then acceleration is uniform.

Generally, the approximate weight of each car is determined as the car starts its downgrade movement from the hump. An electrical device in a special rail causes a selection to be made placing each car in its weight classification as light, medium, or heavy. An

Complex switch patterns . . . simply set . . . with

PROGRAMONITOR

low-cost automatic circuit control


Special 7-circuit
PROGRAMONITOR

INSTANTANEOUSLY RECYCLES AT HIGH SPEED WITHOUT SKIP OR LOSS OF COUNT

- Easily adjusted settings up to 4000 counts — with any number of intricate, progressive switch patterns within a cycle.
- Ends need for change gears, complex cam systems, costly control circuits, awkward mechanical stops.
- Unique design for wide range of machine applications — or modification for specific needs.

For help with *special* circuit control problems requiring design of new equipment, *call on our research and development specialists at the planning stage.*

WRITE FOR BULLETIN 505

COUNTER & CONTROL CORPORATION

4511 WEST BROWN DEER ROAD • MILWAUKEE 18, WISCONSIN

Circle 745 on Page 19

Get Easier, More Accurate Cylinder Speed Control

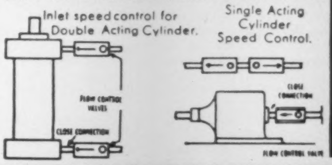
PNEU-TROL®
BELLWOOD, ILL.
PAT. 2,841,174

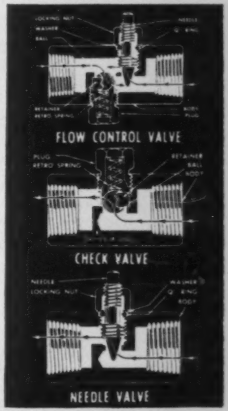
with **Pneu-Trol**® **VALVES IN AIR OR HYDRAULIC USE**

2,000 (brass or aluminum) and 5,000 (steel) p.s.i.

Pneu-Trol Valves combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to seat, requiring only a slight differential pressure to fully open or close it. Check Valve and Needle Valve incorporate single function features of Flow Control Valve. All valves available in 5 female pipe sizes — 1/8" to 3/4". Valve bodies are made from brass, aluminum, steel or stainless steel. Attractive Prices — Immediate Delivery.

Write for Illustrated Circular and Price List.


Inlet speed control for Double Acting Cylinder.
Single Acting Cylinder Speed Control.
FLOW CONTROL VALVES
CLOSE CONNECTION
CLOSE CONNECTION
FLOW CONTROL VALVE

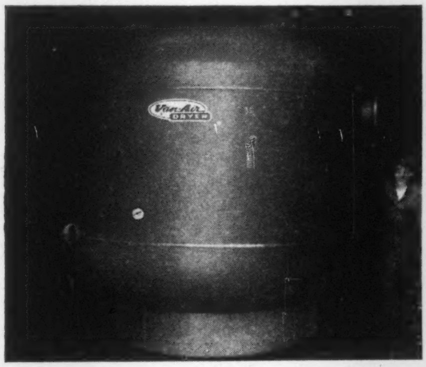

LOCKING NUT
WASHER
BALL
NEEDLE
O RING
RETAINER
RETRO SPRING
BODY
PLUG
FLOW CONTROL VALVE
PLUG
RETRO SPRING
RETAINER
BALL
BODY
CHECK VALVE
NEEDLE
LOCKING NUT
WASHER
O RING
BODY
NEEDLE VALVE

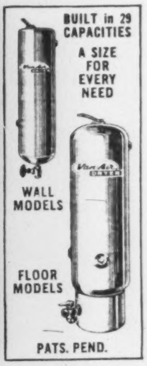
AUTOMATION AUTO-PONENTS INC COMPONENTS®

2939 GRANT STREET

BELLWOOD (Chicago Suburb) ILLINOIS

Circle 747 on Page 19


Van-Air DRYER


BUILT in 29 CAPACITIES
A SIZE FOR EVERY NEED
WALL MODELS
FLOOR MODELS
Van-Air DRYER
PATS. PEND.

VAN-AIR DRYER (above) DRIES and CLEANS COMPRESSED AIR at rate of 6000-cfm—sufficient for ENTIRE PLANT. 28 other sizes of VAN-AIR Dryers COVER COMPLETE RANGE OF PNEUMATIC OPERATIONS down to 1-cfm.

COMPRESSED AIR DRYERS FOR ALL PLANT OPERATIONS

Equipped with exclusive triple-desiccating chamber, VAN-AIR Dryers extract all water from compressed air—remove foreign particles and gaseous oils—destroy bacteria—reduce moisture below zero F dewpoint—operate WITHOUT heat, power, regeneration, injection or volume loss—perform continuously and automatically at the exceptionally low cost of

LESS THAN 1/16-CENT PER 1000 CU. FT.

At this low rate—under 1% of cost to compress air (national average)—VAN-AIR Dryers prevent freezing, corrosion, contamination, dilution—protect air lines, controls, tools, processes, instruments, chemicals, foods, drugs, spraying, blasting, finishing, packaging, etc. Can be installed outdoors. Will not freeze.

Van-Air® DRYER

PLANT ENGINEERS—Look into the DOLLAR value and PENNY maintenance of Van-conditioned dry air—clean, pure, sterile. Ask for brochure with charts.

VAN PRODUCTS CO. ★ Engineers ★ Manufacturers

5806 SWANVILLE ROAD, ERIE, PENNSYLVANIA

Circle 746 on Page 19

AGASTAT
2112-D-H1
28V DC
.030-10 SEC.
3 SEC.
M 500
MINIATURE AGASTAT

Now! **get complete data on**

MINIATURE AGASTAT®

time / delay / relays

This free folder contains complete specs on 24 models of the miniature AGASTAT Time Delay Relay for missile, aircraft, computer, electronic and industrial applications. They're small as 1-13/16" x 4-7/16" x 1½", with adjustable timing ranges starting at .030 and as high as 120 seconds.

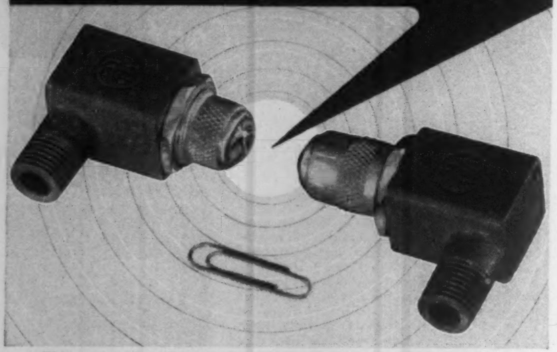
The folder gives operating and environmental specs, coil data, contact capacities, dimensions, diagrams of contact and wiring arrangements. *Write:* Dept. A33-1123.

AGA DIVISION **ELASTIC STOP NUT CORPORATION OF AMERICA**

Elizabeth, New Jersey

Circle 748 on Page 19

MINIATURE PHOTOELECTRIC SCANNERS
Provide for beam-interruption by 1/32″ object



This exceptionally small, precise sensing device assures ultra-precise limit switching, machine and edge control; actuates controls in production or inspection lines.

FEATURES:

- Operated by direct beam, or by reflected beam when heads are mounted side by side in special installations.
- Dark or light energizing; response to beam-interruption of less than 1 millisecond with adjustable relay hold-in time; delayed relay response adjustable to 1 second; direct relay operation provided by 3 types of relays.
- Cadmium-selenide photocell gives short-span, moderate-speed operation; adding an electronic relay increases distance to 6 feet. Lead-sulphide cell with electronic relay gives high-speed operation, sharp resolution.
- Heads have provision for panel mounting, rear-of-housing attachment, or conduit mounting with 1/4″ pipe thread.
- Life of light source in excess of 5000 hours.

Write
for
data sheet.

FARMER ELECTRIC
Products Company, Incorporated
2300 WASHINGTON ST. NEWTON LOWER FALLS, MASS.

Circle 749 on Page 19

WE design and build
high quality automation lines
and special equipment.
Write, or call WHitehall 2-8300
for information.

ADC

AUTOMATION
DEVELOPMENT CORP.
135 Reynolds Road · Mentor, Ohio
(Near Cleveland)

Circle 750 on Page 19

important use of this weight information is to select the proper range of braking pressure applied by the retarder so that the particular car may be braked effectively and smoothly. Failure to adjust the braking pressure to suit the weight of a car could result in rough handling of light cars and require unnecessarily long retarders for heavy cars. The information regarding the weights of the cars is delivered to the proper retarders by the relays of the switching equipment.

Tests have shown a relationship that permits the determination of the rolling resistance of a car on any degree of curvature if the rolling resistance has been measured on a known degree of curvature. Since the free rolling car must traverse sections of both curved and tangent track as it proceeds to its destination, both factors must be known. Therefore, instrumentation is provided for the measurement of rolling resistance on both configurations of track.

The distance which a car must move after it leaves the last retarder and before it couples with the string of cars on a selected track is important information which must be fed to the computer. One method which has been used is to count the cars as they go to the selected tracks. This is an excellent method if all the cars move at exactly the proper speeds to their coupling points. However, there is still the problem of occasional stalling of cars. Stalling may be caused by changes in the characteristics of cars after they have passed the measuring points; introduction of cars whose characteristics fall outside the parameters for which the yard was designed; or release of cars on which the brakes have not been fully released. The latter cause is taken care of by inspection of the brakes on all cars before they go over the hump.

It is evident that the method used must measure the distance to the nearest car on the selected track and determine whether that car is moving or not. The scheme which appears to solve this problem most satisfactorily is based upon measuring the electrical impedance of the particular track on a continuous basis. At any instant the impedance is a measure of the distance to the nearest car. Motion of that car is detected by measuring the electrical noise produced by the car wheels as they move over the rails and experience minutely different values of contact resistance.

The accepted method for moving a stalled car to coupling is to use a locomotive for the trimming operation. It does not appear logical to use regular locomotives and crews for this purpose when one or more small, remotely controlled pushers could be placed at the disposal of the tower operator. Furthermore, it appears feasible that control of the humping locomotive could likewise be placed in the hands of the operator. These two applications of remote control have the potential of bringing about further economies of operation, decreasing the damages, and speeding up the over-all operation.

From a paper entitled "Instrumentation and Economics of Automatic Freight Car Classification" presented at the 14th Annual Instrument-Automation Conference sponsored by the Instrument Society of America, Chicago, Sept. 1959.

Paying too much for PARTS FEEDERS?

NOW YOU CAN GET THE BEST . . . FOR LESS

BEFORE YOU BUY BE SURE TO CHECK OUR NEW LOW PRICES . . .
Send part sample and requirements of job for firm price

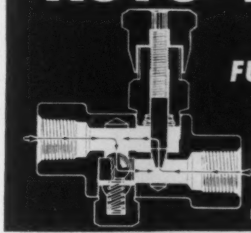
Standard Hoppers—PRICES*

14″ diameter	185.00
16″ diameter	205.00
18″ diameter	225.00

Above prices include 115 volt totally enclosed electric motor. 220/440 volt motor $10.00 additional.
**Tracks extra. Send sample parts for quotation.*

Feedmatic-Detroit, Inc.
P. O. Box 4935 • Detroit 40, Mich.
PHONE: KE 7-0690

AUTO-PONENT®



HYDRAULIC FULL FLOW VALVES

Flow Control, Needle, Check, for HYDRAULIC Power

Model KF Flow Control Valve with Dial and Knob adjustment for direct reading and duplicating reference. Now available in Aluminum for 3000 psi.

Pat. #2,841, 174

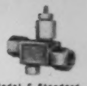
A complete line: 1/8″, 1/4″, 3/8″, 1/2″, and 3/4″ female Dryseal Pipe Sizes in all models and types. Equivalent Aeronautical Tube Sizes on special order.

MINIMUM PRESSURE DROP AND POWER LOSS . . . Oversize ports and passages give maximum flow at minimum pressure drop, insure greater accuracy and response in hydraulic or large volume air cylinder control.

EASY FLOW ADJUSTMENTS under full pressure. Seal located at port to eliminate air or dirt traps. Gland structure equally effective on pressure or vacuum.

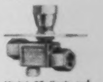
SENSITIVE, CHATTERLESS BALL CHECK . . . Patented design insures rapid ball movement to open or close at low differentials.

FORGED BODIES permit higher pressures with wide safety margins. Aluminum—3000 psi; Steel and Stainless Steel—5,000 psi. Pressure ratings based on better than 5 to 1 safety factor. All internal parts are Stainless. Write for illustrated catalog.



Model F Standard Flow Control Valve or Model N Needle Valve

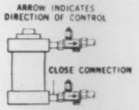
Model KF Knob and Dial Flow Control Valve or Model KN Needle Valve.



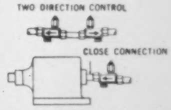
Model PF Knob and Dial Flow Control Valve or Model PN Needle Valve for panel mounting.

Model C Check Valve for In-Line Mounting.

TYPICAL APPLICATIONS



Controlling Double Acting Cylinder

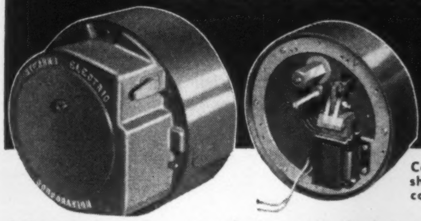


Controlling Single Acting Cylinder

AUTOMATION AUTO-PONENTS INC COMPONENTS®
2939 GRANT STREET
BELLWOOD (Chicago Suburb) ILLINOIS

Circle 752 on Page 19

NEW "42,000 series" *Stearnetic** DISC BRAKES



(The choice of leading electric motor manufacturers)

Cover removed to show Stearnetic* construction.

* *Stearnetic* — Stearns exclusive unitized, electro-magnetic operating mechanism.

- Up to 33% shorter
- Up to 50% lighter
- Max. torque 125 to 575 lb ft
- AC or DC—all single phase — only 2 lead wires
- For standard or straight-thru shafts
- Standard motor or floor mounting — two styles of enclosure
- Exclusive Stearns 1-point adjustment for wear
- Variable torque to match application

Send for Special Information Sheet No. 2Q.

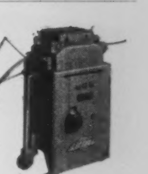
Stearns ELECTRIC CORPORATION
120 NORTH BROADWAY
MILWAUKEE 2, WISCONSIN
Phone: BRoadway 2-1100

Circle 751 on Page 19

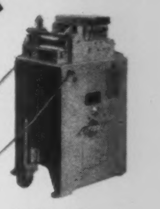
LITTELL
COIL STOCK STRAIGHTENERS

The trim look of these Littell Straighteners is widely copied, but not their performance! They take the curve out of coil stock with efficiency that only Littell engineering experience can assure.

Straighteners shown handle stock .010″ to .125″ thick, up to 12″ wide. Variable speed drives. Electric Clutch and Brake Models. Hydraulic Drive models.



Model 208 for thin stock and parts to 8″ wide, .010″ to .040″ thick.



Models 308 and 312 for stock 1″ to 12″ wide, .018″ to .065″ thick.

Write for Catalog "C"

Today's order ships tomorrow!

Model 412 for stock up to 12″ wide, .040″ to .125″ thick.

F. J. LITTELL MACHINE CO.

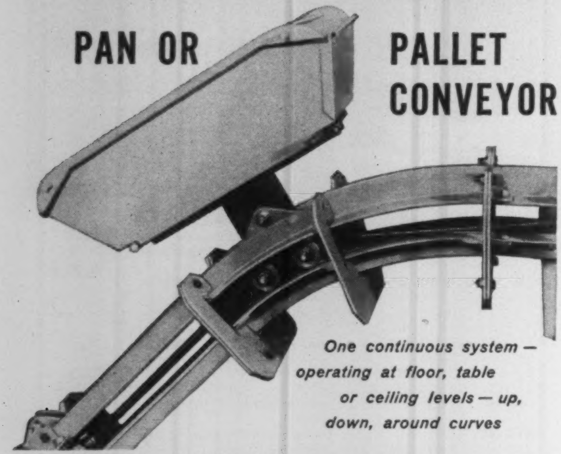
SERVING USERS OF COIL STOCK
Branches: Detroit Cleveland

4105 N. RAVENSWOOD AVE., CHICAGO 13, ILL.

Circle 753 on Page 19

AMERICAN "Chainless"

PAN OR PALLET CONVEYOR



One continuous system — operating at floor, table or ceiling levels — up, down, around curves

One American "Chainless" Conveyor, with a single drive unit, can do work which otherwise requires a complicated system of powered belt or roller conveyors with a number of drive motors and transfer points. The continuous "Chainless" conveyor negotiates horizontal or vertical curves, and can be extended to almost any length. Pallet attachments can be used in place of pans. Eight-wheeled trolleys have exceptional stability. Write for Catalog CD-B.

CONVEYOR DIVISION
THE AMERICAN MONORAIL CO.
Fourth & Franklin Streets • Tipp City 3, Ohio

Circle 754 on Page 19

from MAMMOTH to MIDGET Decco® means DEPENDABILITY and LONGER SERVICE LIFE in INDUSTRIAL SOLENOIDS

DECCO solenoids' unique engineering features and top quality materials have greatly extended their service life.
There is a DECCO solenoid to meet your requirements. Oil immersed, push or pull, shock mounted, A.C. or D.C., mammoth or miniature, they have to be good to be DECCO. Write for catalog.

DETROIT COIL COMPANY
2435 Hilton Road • Ferndale 20, Mich.

Circle 755 on Page 19

are you stuck?

confidential file

Readers with problems concerning systems, equipment, or components for automated operations are invited to outline them to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. Readers having solution suggestions are invited to submit them and should refer to case number and title of the problem involved. Dates shown with suggestions indicate issue in which the problem was presented.

CASE 1957-P

HOSIERY HANDLING

. . . There is a great need in the hosiery industry for some type of automatic or conveyor rise order taking system. The lots handled in the average Finishing Room, out of what we call paired stock or semi-finished goods, are very small. If there is any special company which you might recommend I would appreciate it. . .

President

CASE 1954-P

CARD STACKING

. . . I would appreciate receiving information on method or equipment that would count, jog, and stack folded cards onto a moving belt in piles of twelve or twenty-four. The cards will be belt delivered at the rate of 40,000 per hour. The size of the cards will vary from approximately 3 by 5 to 6 by 10 inches. The size of card and count will be constant for any particular run, which may go as high as 500,000 cards. . .

Plant Engineer

CASE 1949-P

MEASURING MOISTURE IN RUBBER

. . . We are faced with a problem in moisture detection in GRS rubber. Rubber is conveyed from a dryer (on a wide belt) in the form of crumb of varied size, roughly 1/4-inch diameter. It is required to have less than 0.4 per cent water content, reasonably well distributed. Some automatic moisture measuring device is required. . .

Consulting Engineer

CASE 1970-P

TAPE CONTROLLED KNITTING

. . . We are studying the feasibility of using a punched tape or similar method for selecting needles on a flat bed knitting machine. There are 40 needles on each of the two beds in the machine. It will be desirable to select any one or group of needles on each bed. We may require as many as 500 selection patterns on a setup. Setups may be changed as often as twice daily. The machine may operate at 100 strokes per minute and would require a selection pattern for each stroke. What firms make multiple tape reading equipment and also any allied equipment such as small diameter solenoids to motivate selections. . .

Plant Engineer

SUGGESTIONS FOR 1883-P (Aug. 1959)

TUBING CUTOFF CONTROL

. . . Cutoff stops may be made adjustable in a variety of ways. Either of two general methods may be used, depending on several factors. One method is to have a movable stop that is adjustable over the cutoff range. The other is to have a series of fixed stops that can be moved into engagement at will. We should like the opportunity of studying the problem. . .

Edwin L. Marshall
E. Marshall & Co. Inc.

. . . We have several possible solutions to the problem of automatic power adjustment of stops for an automatic positioning table. We also have done some work with flying cutoff of tubing consistent with the accuracy requirement of this job. . .

Frank M. Foster
Planet Products Corp.

. . . I would expect to use a modified preset counter and measuring wheel. If slip occurs more special equipment will be required. Length would be set on dials, perhaps with one or more extra sets of dials so that one setting could be made while another was running. . .

John M. Graham
Graham & Associates

SUGGESTIONS FOR 1902-P (SEPT. 1959)

ADHERING DISCS TO CARDS

. . . We have quite a line of dispensing apparatus which can give small amounts with real accuracy when required. The attached bulletin covers the most popular of our dispensers. . .

Gerald A. Koetting
Lincoln Engineering Co.

. . . There will be no standard machine. We should be in a position to design and build such a machine but not for 8-10 months. We advise: For glue application—Potdevin Machine Co., 227 North St., Teterboro, N. J.; for glue—Morningstar-Paisley Inc., 630 West 51st St., New York 19, N. Y. . . .

Herbert J. Klug
Vertex Co.

SUGGESTION FOR 1951-P (OCT. 1959)

BEVELING SHEET EDGES

. . . Case is of interest to us and we may possibly have the answer. Will you please send me information concerning the company involved or the source of this problem so that we can pursue it further. . .

M. D. Stepath
Arcair Co.

SUGGESTIONS FOR 1892-P (SEPT. 1959)

BURNER CONTROL

. . . We are certainly interested in this application and would appreciate having full information so that we can contact this reader with our recommendations. . .

Summer B. Ladd
General Controls Co.

. . . If you will let me have the name and address of the plant engineer, we will contact him to get more detailed application information . . .

Orin R. Benson
Foxboro Co.

. . . We have a method of proportionately controlling the heights of a gas burner flame by temperature response which we believe may be of interest to this plant engineer. . .

Paul W. Maynard
VecTrol Engineering Inc.

Licensed under
Pat. No. 2481404

Eliminate
HYDRAULIC HOSE
FLEXING FAILURE
with

EASTMAN
SWIVEL CONNECTORS
for industrial applications

STANDARD STYLES

Makes flexing installations on industrial and machine tool applications the strongest link in your hydraulic system. Permits full rotation, friction-free under pressures up to 5000 psi.

Design assures "balanced" fluid flow at required pressure, at any angle. Double seals at each end of stem balance fluid pressure, causing body to "float" on stem, free of end load, at low torque.

Various combinations of stems can be interchanged with any body style. Sizes—½" through 1½".

WRITE for Eastman Technical Bulletins Nos. 100 and 200 on High, Medium and Low Pressure Hydraulic Hose Assemblies.

Eastman MFG. CO.
Dept. A-11, Manitowoc, Wis.

Circle 756 on Page 19

For Highest Precision and Dependability

CARL ZEISS
JENA

LARGE
TOOLMAKER
MICROSCOPE

6" x 2" RANGE
11" Diameter Built-in
Rotary Table
Indexing Full 360°

For the Complete Story of this Outstanding Precision Tool — Contact any of our 3 "Coast to Coast" Locations or your nearest Local Distributor.

SCHERR-TUMICO
PRECISION MEASURING TOOLS AND INSTRUMENTS

Eastern Office: GEORGE SCHERR CO., INC.
200 Lafayette Street • New York 12, N. Y.
Midwest Office and Factory: TUBULAR MICROMETER CO.
St. James, Minnesota
West Coast Office: SCHERR-TUMICO CO.
3337-39 West Olympic Blvd. • Los Angeles 19, Cal.

Circle 757 on Page 19

CUMULATIVE EDITORIAL INDEX

Including June 1959 through November 1959. Number preceding hyphen is month of issue; those following are page numbers.

Accounting, 8-46
Adhering discs to cards, problem, 9-148; 11-171
Adjustable speed drives, 9-140
Allen, J. V.
  Producing Coil Assemblies, 7-62
Aluminum casting, 11-80
Analysis, machine capability, 9-144
Anderson, G. B.
  Automated Maintenance Shop, 9-66
Aronson, T. F.
  Producing Coil Assemblies, 7-62
Assembly,
  automated, 7-62; 11-17
  by riveting, 6-87
  by welding, 7-53
  complex devices, 10-56
  electronic circuit boards, 6-82
  machine for locks, 8-70
  of instruments, problem, 7-132; 9-151
  of mops, problem, 8-141
  setscrew insertion, 9-79
Automation,
  and labor, 7-43
  and the economy, 10-17; 11-22
  at racetracks, 6-134
  buyer-builder relations, 11-58
  in banks, 6-12
  in powerplant, 9-64
  in railroad freight yard, 11-165
  in railroad repair shop, 8-133
  in warehousing, 11-86
  philosophy, 7-43, 44; 10-42; 11-68
  planning for, 7-9; 9-48
  Western metals industry, 11-51
Automobile parts manufacture, 7-77; 11-45

Balancing machine, 7-30
Ball mills, 8-57
Bast, C.
  Designing Control Panels, 6-77
Battles, R. S.
  Riveting Is Modern, 6-87
Baughman, G. W.
  Automatic Freight Car Classification, 11-165
Beadle, R. G.
  Automatic Gage Control of Metal Rolling, 10-76
Blasting, for burr removal, 7-77
Bolz, R. W.
  A Matter of Class, edit., 11-57
  Engineering Automated Equipment—Who Pays?, 11-58
Bottle capping, 7-85
Box dumping, 11-65
Brazing, 6-10
Brown, R. A.
  Static Control, 9-82
Buffing, 9-63
Building blocks, 8-39
Bunnell, T. R.
  Manufacturing Engineering, 9-48

Capital, 6-47
Card controlled, machine tools, 8-9
Carton routing, 6-63
Casting, 8-82
  aluminum strip, 11-80
Check weighing, 11-79
Chlorine analyzer, 8-32
Chojnowski, S. A.
  Radio Controlled Phosphating Line, 11-98
Chucking electrostatically, 6-10
Circuits,
  electropneumatic, 8-62
  latching relay, 8-62
  machine sequence, 11-161
  printed, 11-12
  static control, 9-82
Classifying, freight cars, 11-165
Cleaning-coating machine, 9-58
Closing, wirebound boxes, 11-65
Clutches, electrically controlled, 10-69
Coating machine, 9-58; 11-12
Codes, electrical, 6-77
Coil winding, 7-62; 10-42
Color matching, 6-10
Communication, buyer-builder, 11-58
Components, modular drill head, 10-66
Computers, 7-35
  for business data handling, 10-17
  for freight car dispatching, 11-165
  for process control, 7-24, 70; 10-12; 11-10, 90
  for racetrack odds, 6-134
  in color matching, 6-10
Conferences,
  industrial hydraulics, 10-9
  ISA instrumentation - automation, 9-9
  National Packaging Forum, 11-10
  printed circuits, 10-10
Continuous casting, 11-80
Controlled volume pumps, 11-82
Controls,
  adjustable speeds, 9-140
  assembly machines, 7-62
  batch weighing, 6-77
  burner, problem, 9-148; 11-171
  coal processing, 9-81
  coke making problem, 7-132
  computers, 7-70; 11-90, 165
  conveyor system, 6-63, 74; 7-9, 86; 8-62; 10-23
  drum grouper, 9-53
  electric, 8-77
  electromechanical timer, 10-62
  fault location, 7-62
  flow, 11-82
  fluid-power, 7-136
  freight car dispatching, 11-165
  freight car identification, 6-9
  freight car speed, 11-165
  hydraulic feed, 9-12
  latching relay, 8-62
  limit switches, 9-89; 10-67
  localized proportional, 11-97
  machine tools, 8-133; 9-82; 11-161
  magnetic tape, 10-139
  metal rolling mills, 10-76
  meter-relays, 9-12; 11-77
  metering & proportioning, 11-82
  numerical, 7-22
  numerical controlled flame profiling machine, 6-68
  numerical controlled machine tools, 8-9; 10-82; 11-9
  of lamination press, 7-79
  of mechanical power, 10-69
  of motion from film, problem, 8-142
  offshore gas well, 10-10
  panel design, 6-77
  pH of process solutions, 10-72; 11-82
  photoelectric, 6-63
  pipeline, 9-80
  pneumatic, 8-77
  power, 10-143
  process, 7-70; 8-77; 11-82
  punched card, 6-82
  punched tape, 10-82
  radio controlled phosphating line, 11-98
  record playback, 7-59; 10-139
  reliability, 9-47
  servo, 7-80; 8-133
  static, 6-37, 54; 9-82; 10-143
  stretch forming, 10-33; 11-77
  strip speed & tension regulation, 9-58; 11-17
  tubing cutoff, problem, 8-141; 11-171
  turning lathes, 9-66
  weighing, 9-64; 11-79
  yield point, 11-77
Conveying, 8-82
Conveyors,
  bulk material, 8-135
  concrete mat casting, 10-48
  continuously circulating, 7-9, 86
  interlocked systems, 9-53
  order picking, 8-62
  package sorting, 6-74; 10-14, 62
  packaged sugar, 6-54
  pneumatic, 7-78; 8-135
  programmed, 10-23
  reversing parts, 10-14
Conveyors and cableways, safety code, 7-136
Cookie sandwiching machine, 11-12
Cooling materials, 9-10
Cost analysis, 8-46
Costs, 6-47; 11-17
Counters, 8-14
Counting,
  drapery hooks, problem, 8-141; 10-148
  with isotopes, 7-129
Craig, J. E.
  Sequence Diagrams Speed Machine Troubleshooting, 11-161
Crankshaft turning, 10-37
Cutoff problem, light strip, 10-146
Cutting,
  pipe, 8-28
  steel plates, problem, 10-146
  steel sheets, 6-68
  to size, 10-84
Cylinders, air, 8-21

Data plotting, 7-32
Data presentation,
  for process control, 8-77
  machine sequence, 11-161
Data processing, 6-9, 68; 7-12, 24, 35; 8-146; 9-12; 10-12, 16, 17; 11-174
Data recording, 7-19; 9-14; 11-14, 25
Data storage, 9-30
  magnetic memory, 10-10
  photochromic memory, 6-12
Debugging, 6-48
Deburring, 7-77
  machines, 7-77
Delay, synchronized,
  of data, problem, 9-148
Design,
  integrating product & process, 10-42
  of control panels, 6-77
  packaging systems, 11-68
  simplification, 10-17
  test equipment, 9-73
Detection system, missing cap, 7-85
Developing equipment, 6-48
Diagrams, machine sequence, 11-161
Digital display device, 6-19
Dispatching freight cars, 11-165
Dough making, 10-42
Douglass, A. R.
  Static Control, 9-82
Downtime, control of, 6-59, 11-161
Drilling, 10-37, 66
  machines, 6-131; 11-14
Drives,
  adjustable speed, 9-140
  adjustable voltage, 9-58
  controlled torque, 9-52
Drying plated parts, 10-53
Dumond, D. I.
  Improved Machine Dependability, 6-59
Duncan, F. W.
  Adjustable Speed Control with Modified Kraemer Drives, 9-140

Economics, 6-47; 7-14; 8-46; 10-17; 11-22
  computer control, 11-90
  investment policies, 10-152
  of project selection, 7-44
Education,
  Foundation for Instrumentation Education and Research (FIER), 9-9
Electrical, codes, 6-77
Electrohydraulic servo valve system, 7-80
Electron tubes, 10-17
Electronics,
  circuit developments, 10-42
  in Western states, 10-9
  triple triode tube, 6-26
  tunnel diode, 10-14
Electroplating, 9-152
Electrostatic chuck, 6-10
Electrostatic peening, 7-12
Electrostrictive meter, 7-27
Elevating pellets, problem, 10-146
Engineering,
  cost analysis, 8-46
  drilling service, 10-12
  manufacturing. 7-125; 8-9, 41; 11-57
  of manufacturing processes, 7-10
  of packaging processes, 11-68
Equipment development, 6-48
  assembly, 10-56
Estimating, 6-47
Ethics, buyer-builder, 11-58

Feeders,
  packaging machine, 6-53; 11-68
  rivet, 6-87
  vibratory bowl, 8-70
Feeding,
  brass cup hooks, problem, 6-138
  bulk materials, 7-61
  closures, problem 8-142
  discrete parts, 9-52
  rivets, 6-87
Filling, crates, 11-65
Films, materials handling, 6-22
Finishing, 11-45
Fixture, contour grip, 8-34
Flame,
  cutting machine, 6-68
  detection device, 5-73
Flaw detection, 8-12
Flow control, 11-82
Flow meters, 7-12
Forming, 6-80; 7-62; 11-77
  high-energy spark, 10-10
Foundry, 8-82
Frank, A. C., Jr.
  Manufacturing Engineering and Machine Procurement, 7-44
Furnaces,
  arc melting, 8-14
  continuous annealing, 10-26

Gaging,
  nonferrous strip, 11-97
  post process, 7-77
  sheets problem, 8-142
  thickness, 10-76; 11-17
Germanium growing process, 7-10
Glass, manufacture of, 9-10
Gott, R. C.
  Integrating Product & Process, 10-42
Graphite textiles, 6-14
Grating manufacture, 6-80
Grinding,
  cement, 8-57
  machine drive, 9-140
Grouping, drums of lubricant, 9-53
Gutterman, A.
  Industrial Power Controls, 10-143

Handling,
  air track for, 6-82
  available movie films, 6-22
  broken-lot orders, 8-62
  bulk materials, 7-78; 8-135
  cargo containers, 7-39
  cartons, 6-14, 63
  cement, 8-57
  coal, 8-26; 9-64
  concrete mats, 10-48
  delicate parts, 11-79
  discrete parts, 7-77
  drums of lubricant, 9-53
  folded cards, problem, 11-170
  for welding, 7-53
  foundry, 8-82
  glass tubes, 11-79
  hosiery problem, 11-170
  in narrow aisles, 11-97
  large bearings, 11-98
  magnetic conveyor, 7-79
  mail, 10-14
  motors in storage, 11-97
  packaged sugar, 6-54
  packages, 6-74; 10-62; 11-68
  parts containers, 7-86
  parts for plating, 10-53
  peach packing, 11-65
  railroad wheels & axles, 9-66
  ship cargo, 10-9
  small parts, 8-70
  solenoid chain release, 9-21
  sorting, 10-139
  spools of yarn, 9-80
  springs, 8-70
  stacking, 9-63
  steel pipe, 7-78
  switch mechanism for, 8-70
  transferring, 7-86
  transferring between conveyors, 9-53
  wax slags, 6-53
Hardness testing problem, 8-142
Heat dissipation, in clutches, 10-69
Heat processing, 9-10, 63
Heat treating, 6-65; 10-48
Hohos, J. A.
  Cards Control Assembly, 6-82
Hoists, electric
  wire rope, 10-152
Hydraulics,
  clamping system, 9-27
  conferences, 10-9
  fire resistant fluids, 8-138
  machine feed control, 9-12
  servo valve systems, 7-80

Indexing,
  calculations, 11-174
  table, two revolution cycle, 8-70
Inserting,
  electronic components, 6-82
  setscrews, 9-79
Inspection,
  steel strip, 7-14; 11-14
  testing, 6-24
  ultrasonic tester, 8-12
Interlocks, for assembly machines, 7-62
Inventory control, 7-35

Kilns, 8-57

Lathe, 7-77; 10-37
  drive system, 9-140
Lawson, A. A.
  Cards Control Assembly, 6-82
Limit switches,
  application notes, 9-89; 10-67
  as cause of downtime, 9-47
  standard for, 6-142
Liquid level control, 7-22; 10-12; 11-28
Lloyd, L. B.
  Casting Concrete Mats, 10-48
Loading,
  cargo ships, 10-9
  pallets, 6-14
Lot size, 10-37
Lowe, R. A.
  Cost Analysis and Machine Replacement, 8-46
Lubrication, 6-14

Machine tools,
  automated wheel shop, 9-66
  blanking press, 6-22
  boring, 8-9
  centering through headstock, 8-81
  drilling, 8-10; 10-37; 11-14
  drilling problem, 7-132; 9-151
  forming, 6-80
  lathe, 7-77; 8-81; 10-37
  milling, 8-10
  numerically controlled, 8-9; 9-81; 10-82; 11-9
  presses, 8-41
  prefilling muller, 8-10
  record playback control, 7-59
  single spindle automatic, 11-96
  tape controlled, 6-131
  target drilling, 6-131
  tracer control, 9-66
  transfer, 6-59; 8-39
  transfer machine, 6-37

- Machines,
  - annealing furnace, 10-26
  - assembly, 6-87; 7-62; 8-70; 10-56; 11-17
  - balancing, 7-30
  - burnishing, 10-66
  - capability, 9-144
  - casting concrete mats, 10-48
  - coating & scrubbing, 9-58
  - contour milling, 9-24
  - drilling, 10-12
  - flame profiling, 6-68
  - food processing, 11-12
  - girder welding, 7-79
  - heat exchanger, 9-10
  - knitting, 7-76
  - letter handling, 7-19
  - linecasting, 7-33
  - nail packaging, 7-24
  - packaging, 6-53; 11-43, 68
  - palletizing, 6-14, 54
  - paper making, 10-72
  - phosphating, 11-98
  - pipe cutter, 8-28
  - pipetting, 11-33
  - plating, 10-53
  - procurement of, 7-44
  - reading, 9-14
  - replacement analysis, 8-46
  - riveting, 6-87
  - shiploader, 8-26; 10-9
  - slitting steel strip, 11-96
  - soldering and brazing, 6-10
  - spark forming, 10-10
  - spinning tools, 6-34
  - spring coiling, 10-17
  - stretch forming, 11-77
  - testing, 6-24
  - tube cut-off, 7-10
  - visual packing, 8-37
  - welding, 6-65, 80; 7-53; 9-14, 36
  - woodworking, 8-86
- Magnetic,
  - amplifiers, 9-152
  - clutches, 10-69
  - conveyor control, 10-23
  - ink characters, 6-12
  - limit switch, 11-36
  - memory tape, 6-74; 10-139
  - parts handling, 7-79
  - recorders for control, 10-139
- Magnetic tape,
  - microfilm recording, 11-14
  - programmed broadcasting, 6-43
  - record playback control, 7-59
- Mail processing, 6-74
- Maintenance,
  - machine tools, 6-59
  - railroad wheel sets, 9-66
- Management, 8-46
- Managers, selection & training, 9-152
- *Manildi, J. F.*
  - Modern Developments in Control, 7-70
- Manufacture of,
  - acoustic tile, 10-84
  - aluminum strip, 11-80
  - automobile bodies, 11-45
  - automobile parts, 10-37
  - automotive ignition equipment, 10-56
  - automotive parts, 7-77; 8-41; 9-52; 10-17
  - automotive transmission cases, 6-37, 65
  - circuit breakers, 7-62
  - concrete mats, 10-48
  - distribution transformers, 7-53
  - electronic circuit boards, 6-82
  - glass ampules, 11-79
  - grating, 6-80
  - hardboard panels, 9-63
  - heat exchangers, 6-131
  - hosiery fabric, 7-76
  - incandescent bulbs, 11-10
  - locks, 8-70
  - mill roll bearings, 11-98
  - missile parts, 11-77
  - motor frames, 7-51
  - paper, 10-72
  - Portland cement, 8-57
  - printed circuits, 11-12
  - radiator tubes, 11-97
  - railroad car wheels, 8-133
  - semiconductor solid circuit, 6-22, 31
  - sewing machines, 7-9
  - stepladders, 8-86
  - transformer coils, 11-96
  - transformer tanks, 7-53
  - transistors, 10-16
  - tubesheets, 6-131
- Manufacturing engineering, 7-10, 44, 125; 8-41; 9-48; 11-57, 68
- Manufacturing research, 10-41
- Materials for automation, 10-17
- Measuring,
  - liquid & gas flow, 7-12
  - liquid level, 7-22; 10-12
  - metal gage for mill control, 10-76
  - moisture in rubber, problem, 11-170
  - pH of process solutions, 10-72
- Memory devices, 6-74; 9-14; 11-79, 165
  - electromechanical, 10-62
  - magnetic film, 10-10
  - photochromic, 6-12
- Mercury switch, 8-12
- Meter-relays, 9-12; 11-77
- Meters, fluid, theory and application, 6-142
- Microfilm printer, 7-24; 11-14
- *Miller, W. E.*
  - Automatic Gage Control of Metal Rolling, 10-76
- Models,
  - equipment prove out, 6-48
- Molds, 8-82
- *Moore, R.*
  - Evolving An Assembly Machine for Tumbler Locks, 8-70
- *Muller, J. W.*
  - Handling Broken-Lot Orders on a Warehousing Assembly Line, 8-62

- Negotiation for equipment purchases, 11-58
- Numerical control, 6-68
  - flame profiling machine, 6-68
  - machine tools, 8-9; 11-9
  - milling machine, 9-81
  - profile milling machine, 10-82
  - systems, 7-22; 9-14

- Operations research, 9-152
- Optimizing control, 7-70
- Order picking, 8-62
- Organization,
  - for manufacturing engineering, 7-44, 125
- Orienting, 8-82

- Package sorting, 6-74
- Packaging,
  - cement, 8-57
  - integrating processes, 11-68
  - lines, 8-37
  - machines, 7-24; 11-43
  - research, 7-136
  - wax slabs, 6-53
- Packing peaches, 11-65
- Painting, 7-9; 11-45
- Pallet loading, 6-54
- Paperwork, streamlining problem, 6-138; 9-151
- *Pasion, A. J.*
  - Strip Speed and Tension Regulation, 9-58
- Peening, glass beads, 7-12
- Petroleum processing, 10-10
- pH control of process solutions, 10-72
- pH sampling, problem, 6-138; 9-148
- Philosophy, 6-48; 11-58
- Phosphating large parts, 11-98
- Photoelectric devices, 6-63; 7-85; 9-30; 10-62
- Pipetting machine, 11-33
- Placing tickets, problem, 6-138; 9-151
- Plastic coated steel, 11-12
- Plating machine, 10-53
- Pneumatic,
  - cylinders, 10-21
  - positioning cylinder, 6-82
  - selection system equipment, 8-62
  - tape reader, 7-22
- Portable gage, 11-97
- Positioning,
  - cutting tools, 8-133
  - for welding, 7-53
  - in circuit board assembly, 6-82
  - multiposition cylinder, 6-82
- Potting compound, 6-19
- Power generation, computer controlled, 11-90
- Presses, 8-41
  - blanking, 6-22; 11-9
  - feeding, 9-52
  - wheel mounting & dismounting, 9-66
- Pressure detectors, 10-23
- Priming, 11-45
- Printed circuits,
  - conference, 10-10
  - motors, 9-10
- Printing chain, 11-25
- Process,
  - aluminum strip 11-80
  - computer control, 10-12; 11-10
  - germanium growing, 7-10
  - glass making, 9-10
  - localized proportional control, 11-97
  - planning, 7-44
  - planning packaging, 11-68
  - spark forming, 10-10
  - uranium ore, 7-39
- Processing, checks, 6-12
- Production control, 7-35
- Productivity, 10-41
- Programming,
  - for business data handling, 10-17; 11-174
  - mechanical chain, 7-76
  - of tests, 9-73
  - plating machine, 10-53
  - radio broadcasting, 6-43
  - tape controlled cutting machine, 6-68
  - tape controlled machine tool, 10-82
  - tape preparation, 10-82
- Proportioning,
  - bulk materials, 7-61
  - system, 8-57; 11-82
- Proximity limit switch, 7-85
- Pumping hot liquids, problem, 10-146
- Pumps,
  - controlled volume, 11-82
  - free-piston, 9-21
  - variable displacement, 11-82
- Punched cards, data transmission, 10-16
- Purchasing, 6-142

- Racetrack automation, 6-134
- Radiation thermometer, 11-42
- Radio control crane units, 11-98
- Radioisotopes in industry, 7-32
- Reading,
  - charts, 7-32
  - typewritten material, 9-14
- Record playback control, 7-59; 10-139
- Recording, job shop time, 9-62
- Registration, web problem, 8-142; 10-148
- Regulators, capacity definitions, 10-152
- *Rein, W. J.*
  - High-Speed Plating Line, 10-53
- Relays,
  - actuators, 10-10
  - as cause of downtime, 9-47
- Reliability, electrical components, 9-47
  - of portable equipment, 6-134
- *Render, R. J.*
  - Electrohydraulic Servo Valve Systems, 7-80
- Resistance thermometers, 10-23
- *Ritchings, F. A.*
  - Computer Controlled Power Generation, 11-90
- Riveting, 6-87
  - semi-tubular standards, 10-152
- Rolling mills, gage control, 10-76
- *Ross, G. I.*
  - Automatic Warehousing—the Concept, 11-86
- Routing, freight cars, 11-165
- *Rubin, M.*
  - Automatic Systems Testing, 9-73
- Rule dropper device, 7-33

- Safety code, conveyors & cableways, 7-136
- Sawing acoustic tile, 10-84
- Screening, cement, 8-57
- Sealing, 9-63; 11-68
- Semiconductors, 10-16, 17
  - tunnel diode, 10-14
- Sensing, moving freight cars, 6-9
- Sequence diagrams, 11-161
- Servo valve system, 7-80
- Servomechanisms, design, 8-133
- Servomotor, pulse operated, 7-59
- Set screw driving, 9-79
- *Sharshon, W. S.*
  - Extending Process Control, 8-77
- *Shults, C. J.*
  - Automated Maintenance Shop, 9-66
- Small lot, 10-37
- *Smith, D. N.*
  - Finding & Specifying Production Machine Capability, 9-144
- *Smith, H. R.*
  - Metering and Proportioning Flow, 11-82
- Soldering, 6-10; 7-62
  - electronic components, 6-82
- Solenoids, as cause of downtime, 9-47
- Sorting, 6-74
  - checks, 6-12
  - freight cars, 11-165
  - glass tubes, 11-79
  - mail, 7-19; 10-14
  - packages, 10-62
  - peaches by size, 11-65
  - product units, 10-139
- Specifications in equipment purchases, 11-58
- Speed, regulation, 9-58
- Spin tool machine, 6-34
- Spray painting, 7-9
- Stacking bundles, 9-80
- Standards, 8-39
  - automatic systems, 8-12
  - electrical, 9-82
  - precision snap-acting switches, 8-87; 9-89; 10-67
- Static control, 5-89; 6-37; 9-82; 10-143
- Statistics, machine capability, 9-144
- *Stewart, A. M., Jr.*
  - Electrically Controlled Clutches, 10-69
- Storage,
  - banks between operations, 9-66
  - electric motors, 11-96
  - systems, 11-86
- Stretch forming, 10-33; 11-77
- *Summers, W. A.*
  - Computer Controlled Power Generation, 11-90
- Supervisory control systems, 10-10
- Switches,
  - application notes, 9-89; 10-67
  - controlled rectifier, 10-143
  - crossbar, 9-14
  - definitions of terms, 8-87
  - ignitron, 10-143
  - limit, 9-89; 11-36
  - magnetic amplifier, 10-143
  - mercury, 8-12
  - precision snap-acting, 8-87; 9-89; 10-67
  - saturable reactor, 10-143
  - sequential sampling, 8-24
  - thyratron, 10-143
- Switching,
  - electromechanical, 9-33
  - power, 10-143
  - static, 10-143
- Synchros, design for production, 10-42
- Systems,
  - color matching, 6-10
  - data handling, 11-25
  - order selection, 8-62
  - verbal supervisory, 9-12

- Tape,
  - control of knitting problem, 11-170
  - control of machine tools, 10-82
  - programmed broadcasting, 6-43
  - programmed testing, 9-73
  - reader, pneumatic, 7-22
  - welding, 10-33
- Tape controlled,
  - flame cutting machine, 6-68
  - machine tool system, 6-131; 11-9
  - profile milling machine, 10-82
- Target drilling, 6-131
- *Taynton, R.*
  - Cards Control Assembly, 6-82
- Template tracing, record playback control, 7-59
- Tension regulation, 9-58
- Testing,
  - automatic, 9-43
  - control circuits, 9-82
  - hydrostatic, 7-78
  - machine capability, 9-144
  - missile, 7-39
  - relays, 11-174
  - tape programmed, 9-73
  - transistors, 6-24
  - weapon systems, 9-73
  - welded tubes, problem, 8-141; 10-148
- Testing methods, metals, 7-136
- Thickness gage, 7-14; 8-12
- Timekeeping, 9-62
- Timing, 8-30
- Torque control, 10-69
- Tracing, radioactive isotope, 7-129
- Trade shows, 8-10, 14
- Transducers,
  - current-to-pressure, 8-77
  - pressure-to-current, 8-77
- Transfer machines, 6-37, 59; 8-39
  - welding, 6-65
- Transformers,
  - coils, 9-16
  - design for production, 10-42
- Transistors,
  - applications, 11-174
  - manufacture, 10-16
  - testing, 6-24
- Transmission,
  - process control data, 8-77
  - punched card data, 10-16
- Trinistor triode, 6-32
- Troubleshooting aid, 11-161
- Tubing, nylon, 11-17
- Turnpike operation, 7-35

- Ultrasonic testing, 8-12; 10-12; 11-14

- Valves, 6-28
  - electrohydraulic, 7-22, 80
- *Varlas, G.*
  - Strip Speed & Tension Regulation, 9-58
- Verbal data transmission, 9-12
- Vibration,
  - analysis, problem, 10-148
  - testing, 10-34
- Voltage meter, 7-27

- *Walter, L.*
  - Programming for Numerical Control, 6-68
- Warehousing,
  - philosophy of, 11-86
  - sugar packages, 6-54
- *Way, G. B.*
  - Automatic Systems Testing, 9-73
- Weighing, 11-68
  - bulk materials, 7-61, 78; 9-64
  - glass tubes, 11-79
- *Weiser, G. L.*
  - Assembling Complex Devices, 10-56
- Welding, 6-80; 8-28; 10-152
  - electron-beam, 9-14
  - filler metals, 8-146
  - steel girders, 7-79
  - systems, 6-65
  - tape controlled, 10-33
  - transformer tanks, 7-53
  - ultrasonic, 8-26; 11-22
- *White, R. S.*
  - Developing Unique Equipment, 6-48
- *Whittaker, H. P., Jr.*
  - Radio Controlled Phosphating Line, 11-98
- *Wilburn, J. E.*
  - Integrating Packaging Processes, 11-68
- *Wildanger, E. G.*
  - Magnetic Tape Recorders for Industrial Control, 10-139
- Wiring, as cause of downtime, 9-47

NEW MIDGETS for MAN-SIZED air-oil Flow Control jobs!

Ⓐ **MINIATURE FLOW CONTROL** — Operates on 1 lb. differential. Limited check one direction — full flow other. Recommended working range 0-250 psi. Air flow rate 3.6 CFM at 50 psi.

Ⓑ **MINIATURE NEEDLE VALVE** Precise control of air-oil in either direction. Range 0-2000 psi.

Ⓒ Ⓓ **MINIATURE QUICK CONNECT** — Air flow rate 2.7 CFM at 50 psi. Range 0-150 psi.

Ⓔ **MINIATURE CHECK VALVE** Poppet type, spring loaded. Full flow one direction only. Use in any position. Holds 0-2000 psi. Air flow rate 3.5 CFM at 50 psi.

Clippard Minimatics
TRADE MARK

Write, NOW for NEW BULLETIN No. 8-59

Clippard INSTRUMENT LABORATORY, INC.
7384 Colerain Rd., Cincinnati 39, O. • Phone: JAckson 1-4261
Manufacturers of Miniature Pneumatic Devices, R.F.Coils, Electronic Equipment

Circle 758 on Page 19

METZGAR Floor-to-Floor CONVEYORS HAVE MANY USES

Saves UP TO 9/10 the Cost OF AN Elevator

CAN BE INSTALLED IN STAIR WELL

PUSH BUTTON CONTROL AVAILABLE

ELEVATION BOOSTER IN GRAVITY LINE

Easy to install standard O. A. widths — 18", 22", 30". Length as required. Top quality 3-ply 28 oz. duck with thick traction rubber top. Reversible direction of travel. 3-phase gearhead motor.

CARRIES CONVEYOR OVER FIRE DOORS OR TRAFFIC LANES

ASK OUR ENGINEERS FOR SPECIFIC SUGGESTIONS

METZGAR CONVEYOR CO.
408 Douglas, N.W.
MFRS. OF WHEEL & ROLLER GRAVITY • LIVE ROLLER CONVEYORS • POWER BELT CONVEYORS • SWITCHES • ACCESSORIES
GRAND RAPIDS 4, MICH.

Circle 759 on Page 19

AUTOMATION new books

PROGRAMMING BUSINESS COMPUTERS

By Daniel D. McCracken, Harold Weiss, and Tsai-Hwa Lee; 510 pages, 5¾ by 9 inches, published by John Wiley & Sons Inc., New York; available from AUTOMATION; $10.25 *postpaid.*

Book is intended for readers interested in day-to-day application of computers to business problems. Material covers four main areas: Background on the problem and computers; programming or coding; advanced techniques; and planning of applications. A bibliography and a glossary are included as well as three appendixes, one explaining the binary number system.

Industrial Publications

RELAY TESTING PROCEDURES

Available from National Association of Relay Manufacturers, c/o Prof. Charles F. Cameron, P. O. Box 6, Stillwater, Okla.; paperbound, 70 pages, 8½ by 11 inches; on request.

Progress reports are presented from six subcommittees of the NARM Technical Committee on Relay Testing Methods. Reports cover dry circuit studies, measurement of electrical characteristics, contact life testing, environmental testing (including temperature, humidity, and corrosion), vibration testing, and shock testing.

UNDERSTANDING TRANSISTORS

Available from Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.; paperbound, 64 pages, 6 by 9 inches, illustrated; 50 *cents.*

Simplified discussion serves as an introduction to transistor fundamentals. Applications in amplifiers and oscillators are described.

GRAPHIC AIDS TO FREQUENCY RESPONSE STUDY OF FEEDBACK CONTROL SYSTEMS

Available from Boonshaft and Fuchs Inc., Hatboro Industrial Park, Hatboro, Pa.; looseleaf binding, 25 pages, 8½ by 11 inches; $5.00.

Workbook presents graphs of gain versus phase for linear transfer functions and nonlinear describing functions. Transparent Nichols charts are provided.

ANGULAR INDEXING CALCULATIONS

Available from Pratt & Whitney Co. Inc., Charter Oak Blvd., West Hartford 1, Conn.; 511 pages, 8½ by 11 inches; $11.00.

Tables are presented for indexes to divide a circle into any number of equal divisions from 2 to 210 inclusive. For each index the angular position is given in decimal values of degrees to four places; in degrees, minutes, and seconds; and sine and cosine values are given to eight decimal places.

Advertising Index

A'G'A Division, Elastic Stop Nut Corporation of America 167
Acro Welder Mfg. Co. 156
Aeroquip Corporation 124
Air-Hydraulics, Inc. 175
Airmatic Valve, Inc. 143
Allen-Bradley Co. 37, 38
Alvey Conveyor Manufacturing Co. 21
Alvey-Ferguson Co., The 25
American Brake Shoe Co., Denison Engineering Division 46, 47
American Chain & Cable, Automotive & Aircraft Division 165
American Laundry Machinery Co., The, Olson Filtration Engineers Division 33
American Machine & Foundry Co., Potter & Brumfield Division 151
American MonoRail Co., The, Conveyor Division 170
Anker-Holth Division, The McDowell-Wellman Companies 105
Atronic Products, Inc. 144
Automation Development Corporation 168
Automation Devices, Inc. 30
Automotive & Aircraft Division, American Chain & Cable 165
Auto-Ponents, Inc. 167 169
Autotron, Inc. 156

Barber-Colman Co. 110, 111
Barksdale Valves 135
Beckett-Harcum Co. 140
Bellows Co., The, Division of International Basic Economy Corporation 137
Bell Telephone Laboratories 102
Boston Gear Works 24
Burg Tool Manufacturing Co., Inc. 26, 27

Cincinnati Milling Machine Co., The, Cincinnati Grinding Machine Division 6, 7
Cleveland Vibrator Co., The 164
Clippard Instrument Laboratory, Inc. 174
Counter & Control Corporation 167
Crown Zellerbach Corporation, Gaylord Container Corporation Division 159

Denison Engineering Division American Brake Shoe Co. 46, 47
Detrex Chemical Industries, Inc. 49
Detroit Coil Co. 170
Dynamatic Division, Eaton Manufacturing Co. 141

Eastman Mfg. Co. 171
Eaton Manufacturing Co., Dynamatic Division 141
Edison, Thomas A., Industries, Instrument Division ....Back Cover
Elastic Stop Nut Corporation of America, A'G'A Division 167
Electro Products Laboratories 118
Eriez Manufacturing Co. 42
Exact Weight Scale Co., The 28
Ex-Cell-O Corporation 129

Farmer Electric Products Co., Inc. 168
Farval Corporation, The 8
Fawick Airflex Division, Fawick Corporation 139
Fawick Corporation, Fawick Airflex Division .. 139
Federal Products Corporation 50
Feedmatic-Detroit, Inc. 169
Ferguson, J. L., Co. 113
Ferguson Machine Corporation 142
Flick-Reedy Corporation, Miller Fluid Power Division 133
Fuller Co. 56

Gardner-Denver Co. 122
Gaylord Container Corporation Division of Crown Zellerbach Corporation 159
Gear-O-Mation Division of Michigan Tool Co. 119
General Controls Co. 13
General Dynamics, Stromberg-Carlson Division 43
General Electric Co. 34, 35, 52, 53, 101, 126, 127, 157
General Gas Light Co., Humphrey Products Division 163
General Mills, Nuclear Equipment Department 152
General Motors Corporation, Saginaw Steering Gear Division 16
Gray Equipment Co. 116

Hannfin Co. A Division of Parker-Hannifin Corporation 55, 158
Hansen Manufacturing Co., The 109
Hinde & Dauch Division, West Virginia Pulp & Paper 22
Hughes Products, Industrial Systems Division .. 149
Humphrey Products Division, General Gas Light Co. 163
Hunt Valve Co. 2

International Basic Economy Corporation, The Bellows Co. Division 137
International Business Machines Corporation .. 160
Industrial Electronic Engineers, Inc. 120

Jones, R. A., & Co., Inc. 176

Kearney & Trecker Corporation 121

Littell, F. J., Machine Co. 169
Logan Co. 138
Louden Machinery Co., The 11
Lynch Corporation 115

McDowell-Wellman Companies, The, Anker-Holth Division 105
McGill Manufacturing Co., Inc. 147

Mathews Conveyer Co. 36
May-Fran Engineering, Inc. 146
Mechanical Air Controls, Inc. 154
Metzgar Conveyor Co. 174
Michigan Tool Co., Gear-O-Mation Division .. 119
Micro Switch A Division of Minneapolis-Honeywell Regulator Co. 145
Miller Fluid Power Division of Flick-Reedy Corporation 133
Minneapolis-Honeywell Regulator Co., Micro Switch Division 145
Modern Machine Tool Co. 150
Moog Servocontrols, Inc., Industrial Division..15

Oil-Dyne, Inc. 120
Oilgear Co., The 5
Olson Filtration Engineers Division of the American Laundry Machinery Co. 33
Ortman-Miller Machine Co. 108

Parker-Hannfin Corporation, Hannifin Co. Division 55, 158
Post Machinery Co., Electronic Products Division 148
Potter & Brumfield Division of American Machine & Foundry Co. 151

Reeves Pulley Co. Division of Reliance Electric & Engineering Co. ....Inside Back Cover
Reliance Electric & Engineering Co., Reeves Pulley Co. Division ....Inside Back Cover
Reuland Electric Co. 153
Richardson Scale Co. 39
Rivett Lathe & Grinder, Inc. 31
Ross Operating Valve Co. 1

S-P Manufacturing Corporation, The 114
Saginaw Steering Gear Division, General Motors Corporation 16
Scherr, George, Co., Inc. 171
Sciaky Bros., Inc. 107
Sheffield Corporation, The 54
Simplicity Engineering Co. 166
Southwest Products Co. 164
Sperry Products, Inc. 162
Standard Conveyor Co. 117
Standard Instrument Corporation 166
Standard Tool & Manufacturing Co. 136
Stearns Electric Corporation 169
Stromberg-Carlson A Division of General Dynamics 43

Teletype Corporation 131
Tubular Rivet & Stud Co. 40, 41

U. S. Electrical Motors, Inc. 29

Van Products Co. 167
Veeder-Root, Inc. 32

Wagner Electric Corporation 134
Wean Equipment Corporation ..Inside Front Cover
Weatherhead Co., The, Fort Wayne Division .. 44
West Virginia Pulp & Paper, Hinde & Dauch Division 22

Yoder Co., The 23

AIR-HYDRAULICS
INCORPORATED

CUSHIONED STOP . . .
FOR ACCURATE INDEX

AIR CYLINDER CUSHION CONTROL
AIR SPEED CONTROL

HERE'S YOUR ANSWER, if accuracy and dependability are important to you. Cushioned stop eases work to position. Locking cylinder stops the table "on the money" and holds it until released by locking dog. Changes in loads, diameters or speeds are no problem either, since both speed and cushion are adjustable. Top plate is 15" in diameter but the rugged mechanism will handle much larger work loads. Table will make up to 100 indexes per minute with a 22" diameter, 200 lb. load.

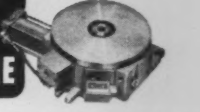
OPERATES on 60-175 lbs. pressure when equipped for air but table is available for either air or hydraulic operation. 4, 6, 8, or 12 stations are standard but others, up to 30, are made to order.

REPRESENTATIVES:
SOME TERRITORIES STILL OPEN.
WRITE FOR INFORMATION.

AIR-HYDRAULICS
INCORPORATED

INDEX CYLINDER
INDEX PIN
LOCKING DOG
LOCKING CYLINDER

HEAVY DUTY
air
INDEX TABLE



NO BACKLASH, SKIPS, OVERRUNS

THE REASONS are simple but important: • Positive index, because the index pin shifts to the new position while table is stationary and is only disengaged by locking dog after indexing • Locking cylinder insures firm seating of dog in ring notch • Cushion stop eliminates wracking jar • Two versatile sizes • Table surface is ground for accuracy • May be mounted vertically or horizontally on all types of presses or other tools where accuracy of register is imperative • Operates on line pressure from 60-175 lbs.

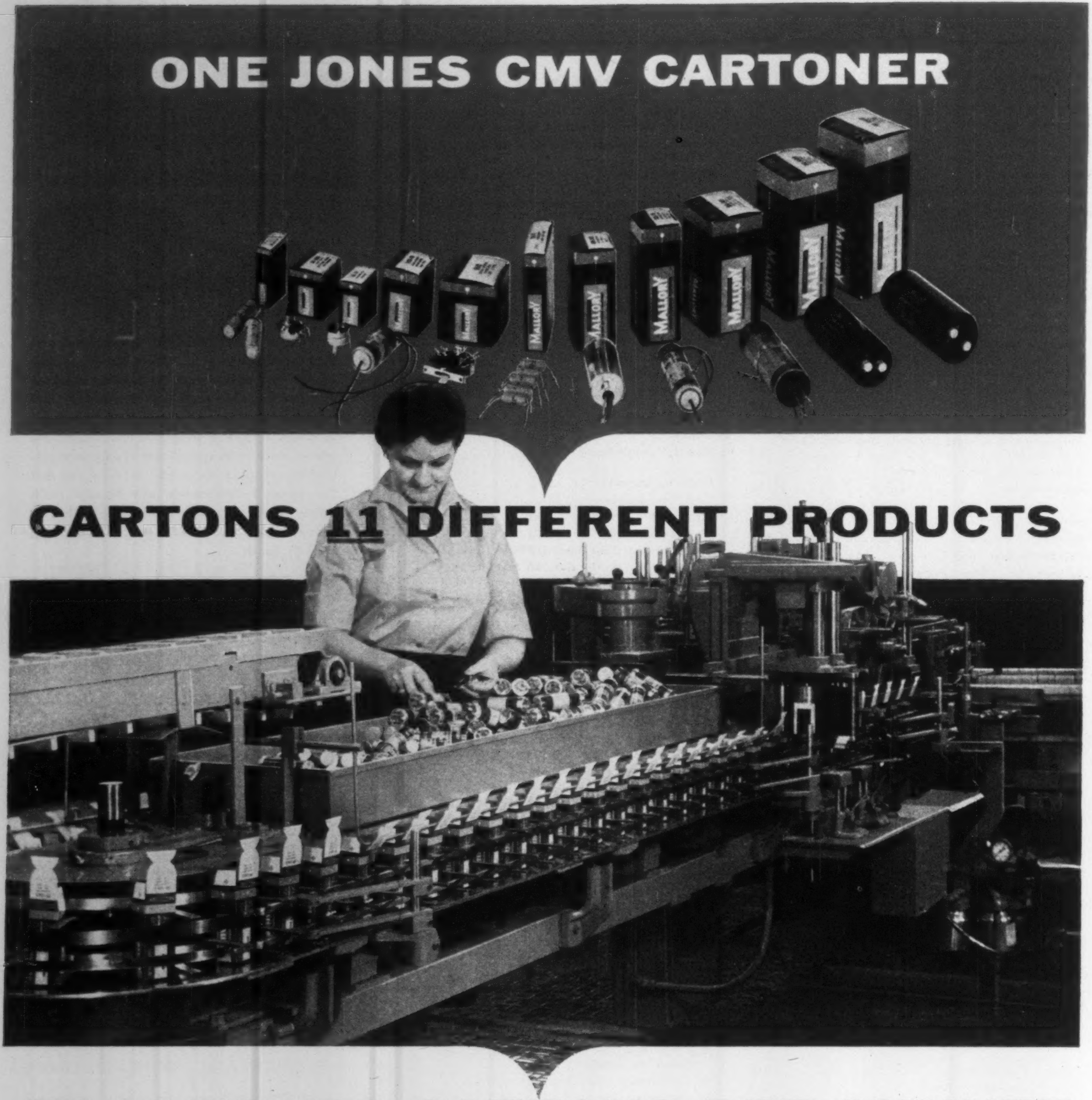
OUR 8 PAGE CATALOG covering presses, hammers, index tables and allied equipment is ready for you now. Write for yours today.

AIR-HYDRAULICS
INCORPORATED

299 HUPP AVENUE
JACKSON, MICHIGAN

Circle 760 on Page 19

ONE JONES CMV CARTONER



CARTONS 11 DIFFERENT PRODUCTS

AT 40 TO 120 CARTONS PER MINUTE

Eighty percent of the radio, tv and other electronic components handled by the Distributor Division, P. R. Mallory & Co., Indianapolis, are cartoned semi-automatically by a single cartoner. The Jones CMV (constant motion vertical) at Mallory cartons 11 different size products, ranging in size from ¾" x ¾" x 3" to 2¾" x 2¾" x 6⅝".

Change-over from one size carton to another takes only 30 minutes with one mechanic.

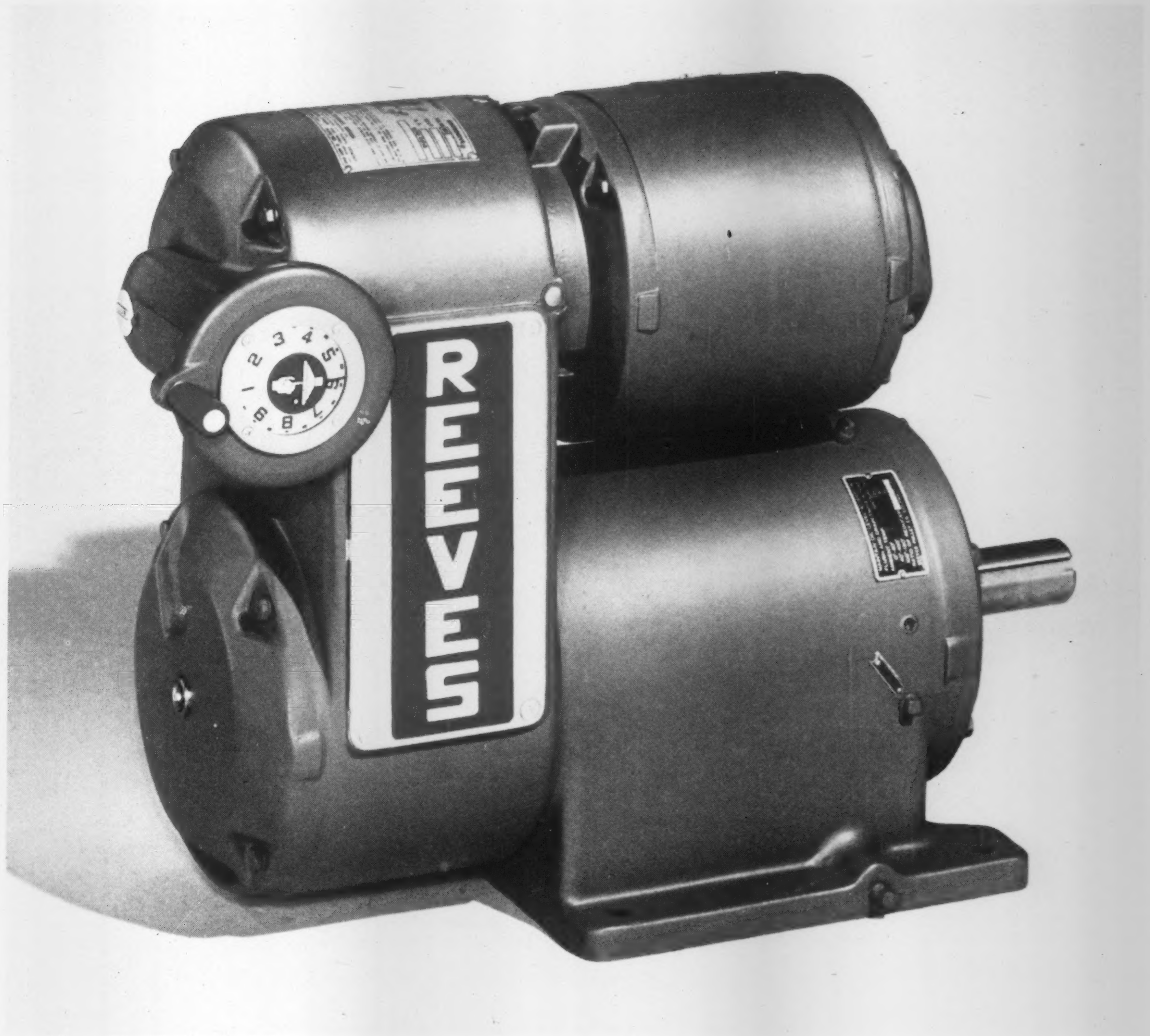
A Jones attachment on the CMV for imprinting parts numbers has further increased Mallory's packaging line speeds. It saves the cost of a separate printing machine, with its extra handling, labor and wasted cartons due to overruns.

Over 200 CMV's are daily speeding up the cartoning of such diverse products as hardware, automotive and electronic parts, drugs, pharmaceuticals, chemicals, cosmetics, toys and dozens of others. For further information, write today for your free copies of CMV bulletin and Cartoning Idea Book.

ATTEND PMMI SHOW. Visit Jones' booth 1015.

R. A. JONES & COMPANY. INC.
Cartoning Machines - Case Packers

P. O. Box 485, Cincinnati 1, Ohio
BRANCH OFFICES
New York • Chicago • St. Louis • Los Angeles
San Francisco • Seattle • Mexico D. F.



REEVES Vari-Speed Motodrive

packed with new flexibility . . . broader production use

Now available in this compact design, Reeves Vari-Speed Motodrives deliver 2:1 through 10:1 speed variation, 1.8 through 4660 rpm . . . ¼ to 20 hp.

The infinitely variable output speeds meet almost every production need.

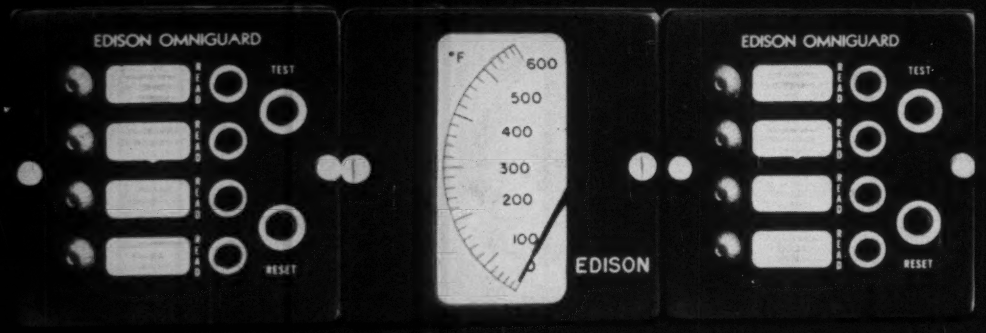
You can get these drives with output shaft on same or opposite side of the motor; vertical, 45°, horizontal or trunnion models; no reducer, and single, double or triple stage reductions . . . hundreds of space saving assemblies. Reeves provides a full range of modifications, accessories, and manual, remote or automatic controls. G-1639

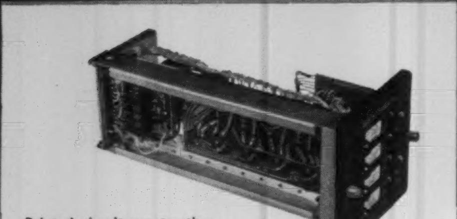
Write today for complete data on sizes 100-500 (¼-20 hp) and sizes 8000 (25-40 hp)

REEVES PULLEY COMPANY
Division of **RELIANCE** ELECTRIC AND ENGINEERING CO.
COLUMBUS, INDIANA
In Canada: Reeves Drives • Toronto • Montreal

R MASTER REEVES

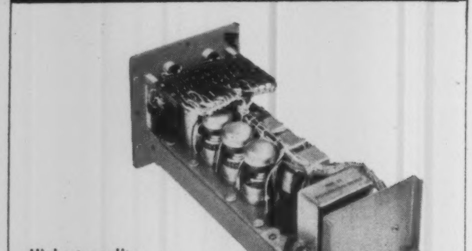
Circle 652 on Page 19



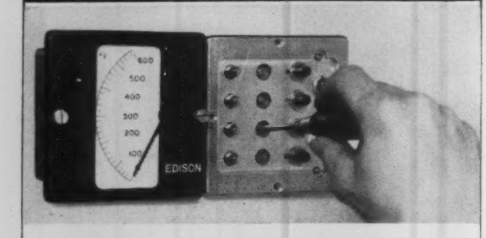


Printed circuit construction increases dependability.

Model 310 Edison Omniguard with Model 311 Indicator — a single indicator can read any number of temperature points.



Highest quality components, with no moving parts, assure maintenance-free operation.



Easy access to all components permits quick temperature settings and monitoring system changes - at any time.

THOMAS A.

EDISON

new model 310 omniguard temperature monitor... unmatched for versatility

The new Model 310 Edison Omniguard provides the simplest, most dependable temperature detection system yet devised... for both small and large installations.

The Omniguard system is reliable... flexible... economical. You order only the plug-in units needed, add new units as your monitoring needs expand.

Check these features of the new Edison Omniguard:

1. **VERSATILE:** One instrument can be used for both normally open and normally closed annunciator... for alarm or for shutdown of equipment.
2. **FLEXIBLE:** Quick, inexpensive system changes and additions . . . easy tie-in with any type annunciators or cut-off switches.
3. **DEPENDABLE:** Rugged design with highest quality components, no fragile moving parts.
4. **SIMPLE:** Single indicator reads any number of temperatures, needs no periodic adjustment. With a minute's briefing, *anyone* can operate the simple Omniguard monitoring system.
5. **LOW COST:** Plug-in units can be custom-tailored to your exact requirements . . . order additional units only when needed.

Thomas A. Edison Industries
INSTRUMENT DIVISION
86 LAKESIDE AVENUE, WEST ORANGE, N. J.

McGRAW EDISON

Circle 653 on Page 19